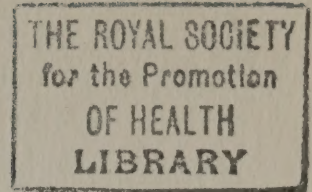
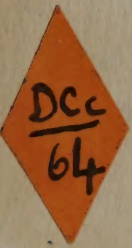


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Cooperative Program for the Certification of Interstate Shellfish Shippers



Part I

Sanitation of Shellfish Growing Areas

1962 Revision



U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service

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FOR THE PROMOTION
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Cooperative Program for the Certification of Interstate Shellfish Shippers

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Part I

Sanitation of Shellfish Growing Areas

1962 Revision

Compiled and edited by
Eugene T. Jensen, Sanitary Engineer Director



U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service

Division of Environmental Engineering and Food Protection
Shellfish Sanitation Branch
Washington 25, D.C.

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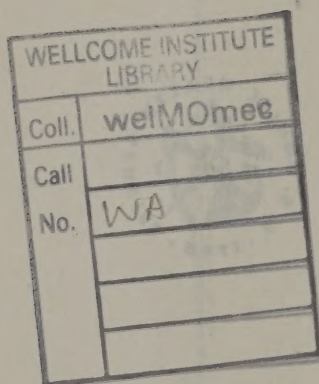
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PUBLIC HEALTH SERVICE PUBLICATION NO. 33

Part I — Revised 1962

**LIST OF PREVIOUS EDITIONS OF MANUAL OF RECOMMENDED
PRACTICE FOR COOPERATIVE PROGRAM FOR CERTI-
FICATION OF INTERSTATE SHELLFISH SHIPPERS—NOW
SUPERSEDED**

1925. Supplement No. 53 to Public Health Reports November 6, 1925 "Report of Committee on Sanitary Control of the Shellfish Industry in the United States".
1937. U.S. Public Health Service Minimum Requirements for Approval of State Shellfish Control Measures and Certification for Shippers in Interstate Commerce (Revised October 1937).
1946. Manual of Recommended Practice for Sanitary Control of the Shellfish Industry Recommended by the U.S. Public Health Service (Public Health Bulletin No. 295).
1957. Manual of Recommended Practice for Sanitary Control of the Shellfish Industry (Part II: Sanitation of the Harvesting and Processing of Shellfish). Printed as Part of Public Health Service Publication No. 33.
1959. Manual of Recommended Practice for Sanitary Control of the Shellfish Industry (Part I: Sanitation of Shellfish Growing Area). Printed as Part I of Public Health Service Publication No. 33.

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Introduction

In 1925 State and local health authorities and representatives of the shellfish industry requested the Public Health Service to exercise supervision over the sanitary quality of shellfish shipped in interstate commerce. In accordance with this request, a cooperative control procedure was developed. In carrying out this cooperative control, the States, the shellfish industry, and the Public Health Service, each accept responsibility for certain procedures as follows:

1. Procedures To Be Followed by the State.—Each shellfish-shipping State adopts adequate laws and regulations for sanitary control of the shellfish industry, makes sanitary and bacteriological surveys of growing areas, delineates and patrols restricted areas, inspects shellfish plants, and conducts such additional inspections, laboratory investigations, and control measures as may be necessary to insure that the shellfish reaching the consumer have been grown, harvested, and processed in a sanitary manner. The State annually issues numbered certificates to shellfish dealers who comply with the agreed-upon sanitary standards, and forwards copies of the interstate certificates to the Public Health Service.

2. Procedures To Be Followed by the Public Health Service.—The Public Health Service makes an annual review of each State's control program including the inspection of a representative number of shellfish-processing plants. On the basis of the information thus obtained, the Public Health Service either endorses or withholds endorsement of the respective State control programs. For the information of health authorities and others concerned, the Public Health Service publishes a semimonthly list of all valid interstate shellfish-shipper certificates issued by the State shellfish-control authorities.

3. Procedures To Be Followed by the Industry.—The shellfish industry cooperates by obtaining shellfish from safe sources, by providing plants which meet the agreed-upon sanitary standards, by maintaining sanitary plant conditions, by placing the proper certificate number on each package of shellfish, and by keeping and making available to the control authorities records which show the origin and disposition of all shellfish.

The fundamental components of this cooperative State-Industry-PHS shellfish certification program were first described in a *Supplement to Public Health Reports*, "Report of Committee on Sanitary Control of the Shellfish Industry in the United States" (1925). This guide for sanitary control of the shellfish industry was revised and reissued in 1937 and again in 1946. It was separated into two parts by publication of Part II, Sanitation of the Harvesting and Processing of Shellfish in 1957 and by publication in 1959, of Part I, Sanitation of Shellfish Growing Areas. The need for a specialized program of this nature was reaffirmed at the National Conference on Shellfish Sanitation held in Washington, D.C., in 1954 (1) and at the Shellfish Sanitation Workshops held in 1956 (2), 1958 (3), and 1961 (67).

This edition of the shellfish sanitation manual has been prepared in cooperation with the State shellfish control authorities in all coastal States, food control authorities in the inland States, interested Federal agencies, Canadian Federal departments, the Oyster Institute of North America, the Pacific Coast Oyster Growers Association, and the Oyster Growers and Dealers Association of North America.

Since the growing and processing of shellfish are two distinct phases of operation in the shellfish industry, the manual has been prepared in two parts: I: Sanitation of Shell-

fish-Growing Areas; and II: Sanitation of the Harvesting and Processing of Shellfish. This, Part I of the manual, is intended as a guide for the preparation of State shellfish sanitation laws and regulations, and for sanitary control of the growing, relaying, and purification of shellfish. It is intended that States participating in the cooperative State-PHS-Industry program for the certification of interstate shellfish shippers will be guided by this manual in exercising sanitary supervision over shellfish growing, relaying, and purification, and in the issuing of certificates to shellfish shippers.

The manual will also be used by the Public Health Service in evaluating State shellfish sanitation programs to determine if the programs qualify for endorsement.

The provisions of this manual were accepted at the Shellfish Sanitation Workshop held in Washington, November 28-30, 1961, and unless otherwise stated become effective 60 days after publication (67).

EUGENE T. JENSEN,

Chief, Shellfish Sanitation Branch, Division of Environmental Engineering and Food Protection, Public Health Service.

Definitions

And/or.—Where this term is used, *and* shall apply where possible; otherwise, *or* shall apply.

Area, growing.—An area in which market shellfish are grown.

Coliform group.—The coliform group includes all of the aerobic and facultative anaerobic, Gram-negative, non-spore-forming bacilli which ferment lactose with gas formation within 48 hours at 35° C. Bacteria of this group which will produce gas from E. C. medium within 48 hours at 44.5° C. in a water bath will be referred to as fecal coliforms.

Controlled purification.—The process of removing contamination from whole live shellfish acquired while growing in polluted areas.

Cooperative program.—The cooperative State-PHS-Industry program for the certification of interstate shellfish shippers as described in Public Health Service Publication Number 33, *Sanitary Control of the Shellfish Industry*, Parts I and II.

Depletion.—The removal of all market-size shellfish from an area.

Most probable number (abbreviated MPN).—The MPN is a statistical estimate of the number of bacteria per unit volume, and is determined from the number of positive results in a series of fermentation tubes. A complete discussion of MPN determinations and computations, including MPN tables, can be found in the American Public Health Association publication "Standard Methods for the Examination of Water, Sewage and Industrial Wastes" (4) (5).

Population equivalent (coliform).—A quantity of sewage containing approximately 160×10^6 coliform group bacteria. This is approximately equal to the per capita per day contribution of coliforms as determined in a metropolitan sewerage system (6) (7) (8).

Sanitary survey.—The sanitary survey is the evaluation of all factors having a bearing on the sanitary quality of a shellfish growing area including sources of pollution, the effects of wind, tides, and currents in the distribution and dilution of the polluting materials, and the bacteriological quality of the water.

Shellfish.—All edible species of oysters, clams, or mussels. Shellfish products which contain any material other than the meats and/or shell liquor of oysters, clams, or mussels will be regarded as a "processed food" and will not be included in the cooperative program (1).

Shellfish, market.—Shellfish which are, may be, or have been harvested and/or prepared for sale for human consumption as a fresh or frozen product.

State shellfish control agency.—The State agency or agencies having legal authority to classify shellfish growing areas and/or to issue permits for the interstate shipment of shellfish in accord with the provisions of this manual.

State shellfish patrol agency.—The State agency having responsibility for the patrol of shellfish growing areas.

Transplanting.—The moving of shellfish from one area to another area.

Section A

GENERAL ADMINISTRATIVE PROCEDURES

1. **State Laws and Regulations.**—State laws or regulations shall provide an adequate legal basis for sanitary control of all interstate phases of the shellfish industry. This legal authority shall enable one or more departments or agencies of the State to classify all coastal waters for shellfish harvesting on the basis of sanitary quality; effectively regulate the harvesting of shellfish; effectively prosecute persons apprehended harvesting shellfish from restricted, prohibited, or non-approved areas; regulate and supervise the shipment and storage of shell stock, and the shucking, packing, and repacking of shellfish; make laboratory examinations of shellfish; seize, condemn, or embargo shellfish; and restrict the harvesting of shellfish from particular areas and suspend interstate shipper certificates in public-health emergencies.

Satisfactory compliance.—This item will be satisfied when the State has legal authority to—

a. Classify all coastal waters as to their suitability for shellfish harvesting on the basis of sanitary quality as defined in Section C of this manual. (It is strongly recommended that a State permit be required for the growing or harvesting of shellfish, and that such permits be revocable or subject to suspension for just cause. It is also recommended that the State have authority to regulate the discharge of sewage, radioactive, and other toxic wastes from boats in the vicinity of approved shellfish growing areas.)

b. Control the harvesting of shellfish from areas which are contaminated or which contain paralytic shellfish poison. To be effective this authority must allow the State to—

(1) Patrol growing areas.

(2) Apprehend persons violating the restrictions.

(3) Effectively prosecute persons apprehended harvesting shellfish from *restricted* or *prohibited* areas. (Penalties for such violations should be sufficient to discourage illegal harvesting.)

c. Regulate and supervise relaying, depletion, wet storage, and controlled purification as described in this manual if these techniques are used.

d. Require that shell stock in storage or in transit from the growing area to the certified shipper be protected against contamination; i.e., every person, firm, or corporation that handles shellfish up to the certified shipper will be subject to sanitary control by an official agency but will not necessarily be required to have a State shellfish permit.

e. Prohibit Cooperative Program shippers from possessing or selling shellfish from out-of-State sources unless such shellfish have been produced in accord with Cooperative Program requirements.

f. Regulate the operations of shucker-packers, repackers, shell stock shippers and re-shippers in accord with the applicable provisions of part II of this manual.

g. Restrict the harvesting of shellfish from specific areas, and suspend interstate shipper certificates in a public-health emergency. **Administrative procedures required in connection with such emergency actions should not require more than one day to complete.**

h. Prevent the sale, shipment, or possession of shellfish which cannot be identified as having been produced in accord with Cooperative Program requirements or which are otherwise unfit for human consumption, and to condemn, seize, or embargo such shellfish. This authority need not be specific for shellfish and may be included in other State food laws.

Public-health explanation.—The Cooperative Program was developed by the 1925 Conference on Shellfish Pollution to meet the specific public-health need resulting from the 1924–25 typhoid epidemic (9).

However, the Cooperative Program has gone beyond the original objective of insuring that shellfish shipped interstate would not be the cause of communicable disease. Thus, in the 1940's, paralytic shellfish poison became a matter of public-health concern and steps were taken to protect the public against this hazard. In 1957 it was recognized that shellfish might concentrate certain radionuclides and that a radiation surveillance activity might become a necessary adjunct to the established procedures.

To accomplish these public-health objectives the State must supervise all phases of the growing, harvesting, transportation, shucking-packing and repacking of shellfish to be shipped interstate. It is also important that shellfish be properly refrigerated and protected against contamination during interstate shipment. This is not easily accomplished by the State of origin although certified shippers are required to pack shellfish in containers which will protect them against contamination.

If State supervision is to be effective all phases of the activity must be supported by legal authority. This authority may be either a specific law or regulation. The success with which the State is able to regulate the several components of the shellfish industry provides a measure of the adequacy of the statutory authority.

The unique nature of shellfish as a food also makes it necessary that the State shellfish control agency have authority to take immediate emergency action to halt harvesting or processing of shellfish without recourse to lengthy administrative procedures. As examples, a State may find it necessary to close a shellfish growing area within hours of a breakdown in a sewage treatment plant or the unexpected finding of paralytic shellfish poison.

Periodic revisions of State shellfish laws or regulations may be necessary to cope with new public-health hazards and to reflect new

knowledge. Examples of changes or developments which have called for revision of State laws include the wide-scale use of pleasure boats with the resulting probability of contamination of shellfish growing areas with fresh fecal material, the conditionally approved area concept resulting from the construction of sewage treatment works, and the apparent ability of shellfish to concentrate certain radionuclides.

Experience has demonstrated that *all* coastal waters of the State must be classified as to their sanitary suitability for shellfish harvesting. Harvesting should be permitted only from those areas which have been found by sanitary survey to meet the sanitary criteria of this manual. Harvesting should accordingly be specifically prohibited from areas which do not meet the criteria, or which *have not been surveyed*.

2. General Administrative Procedures To Be Used by States.—States shall keep records which will facilitate Public Health Service review of their shellfish sanitation programs and shall assist the Service in making such reviews. Effective September 1, 1959, States shall not certify shippers for interstate shipment unless the shipper complies substantially with the construction requirements of part II of this manual and maintains a sanitation rating of at least 80 percent during periods of operation. Shippers not meeting these requirements will not be eligible for inclusion on the Public Health Service list of State certified shellfish shippers. Cooperative Program standards shall be applied to all growing areas, all shellfish harvesters, and all persons handling shell stock prior to its delivery to the Cooperative Program certified shipper. When two or more State agencies are involved in the sanitary control of the shellfish industry, a clear statement of responsibility of each agency should be developed.

Satisfactory compliance.—This item will be satisfied when—

a. Cooperative Program requirements are applied to all market-shellfish growing areas.

b. Cooperative Program requirements are applied to all commercial market shellfish harvesters.

c. Cooperative Program requirements are applied to all persons handling the shellfish prior to its delivery to the interstate shipper.

d. Interstate shellfish shipper certificates are issued only to those establishments substantially meeting the construction requirements of Part II of this manual and which maintain a plant sanitation rating of at least 80 percent during periods of operations. (The State shellfish control agency shall suspend or revoke certificates if a plant sanitation rating drops below 80 percent or if any individual sanitation item is violated repeatedly.) Ratings will be determined on the basis of compliance with the applicable provisions of Part II of this manual as measured by an inspection report comparable to that contained in appendix A of Part II.

e. The following records are kept of shellfish sanitation activities as required in sections C, D, and E, Part I, of this manual and when monthly summaries of State patrol and inspection activities are forwarded to the Public Health Service regional office:

(1) Individual growing area files. (Areas may be defined by either geographic or political boundaries.)

(2) Patrol activities, including arrests, prosecutions, and the results of prosecutions.

(3) Plant inspections. Shucker-packers and repackers shall ordinarily be inspected at least monthly. Shell stock shippers and reshippers shall be inspected at a frequency which will afford adequate public-health supervision of their operations. A central inspection-report file should be maintained by the State.

f. The following guidelines are observed by the State in issuing interstate shellfish certificates.

(1) Certificate content. Each certificate should give the following information:

Name. (The usual business name and alternative names that should appear on the interstate shellfish shippers list, hereafter called "list.")

Address. (A business and/or mailing address in the State issuing the certificate. This address indicates where records are

kept and where inspection may be arranged.)

Certificate Number. (A number shall be assigned for each business unit. Suffix or prefix letters may not be used to differentiate between two or more plants of a given shipper.)

Classification. (The shipper classification should be indicated by a symbol: i.e., shucker-packer, SP; repacker, RP; shell stock, SS; or reshipper, RS. Only one classification should be used. The single classification will cover all proposed operations which the shipper is qualified to perform.)

Expiration Date. (All certificates in a State should expire on the same date, preferably the last day of a month. This date will be shown on the "list". All certificates will be automatically withdrawn from the "list" on the date of expiration unless new certificates have been received by Public Health Service headquarters office. If the date of expiration coincides with the date of issue for the "list" the certificates expiring on the date of issue will be deleted.)

Certifying Officer. (Each certificate is signed by a responsible State official.)

(2) Certificate changes. A change in an existing, unexpired certificate should be made by issuing a corrected certificate.

(3) Interstate shipment before listing. The shipper should be informed of the probable date his name will appear on the "list" and should be advised against making interstate shipment prior to that date. (If shipments must be made before the appearance of the shipper's name on the "list", the Public Health Service will notify the applicable receiving States if the names and addresses of the expected receivers are indicated in advance by the State when the certificate is forwarded to the Public Health Service.)

(4) State cancellation, revocation or suspension of interstate shipper certificates. If a State revokes, cancels, or suspends an interstate shellfish shipper certificate, the Public Health Service regional office should be immediately noti-

fied, preferably by telephone or telegram; with a following confirmatory letter.

(5) Mailing list for interstate shellfish shipper list. Names of persons, business units, organizations, or agencies, desiring copies of the "list", and requests for information concerning the "list" should be sent to the appropriate Public Health Service regional office. Recipients will be circularized periodically to determine if they still have use for the "list".

g. The appropriate Public Health Service regional office is notified by the State of any revision in growing area classification. The notification shall so describe the area that it may be readily located on Coast and Geodetic Survey charts.

h. State shellfish plant inspectors are provided with the following inspection equipment: standardized inspection forms, thermometer, chlorine test kit, and light meter.

i. Interdepartmental memoranda of understanding have been developed which will define the responsibilities of each State agency in maintaining adequate sanitary control of the shellfish industry in the State.

Public-health explanation.—The annual review of each participating State's shellfish sanitation activities is a fundamental Public Health Service responsibility in the Cooperative Program. The purpose of this review is to evaluate the adequacy and reliability of each individual State program in accord with the agreed-upon standards. The Service will endorse those State programs meeting the Cooperative Program standards and will publish and distribute a list of the names of the State certified shippers. However, if a State program does not meet the standards the program will not be endorsed. Names of nonparticipating States will be omitted from the Public Health Service list of State certified shellfish shippers.

Minimum plant sanitation standards for interstate shellfish shippers are described in Part II of this manual. Experience has shown that absolute compliance with these minimum standards is not always attainable, particularly those items which relate to operating procedures. The establishment of the 80 percent plant sanitation score as a prerequisite for listing on the Public Health Service list of State certified shellfish shippers recognizes the fact that perfection is not always obtainable and, at the same time, provides a mechanism for excluding any plant which is not operated in a reasonably sanitary manner.

Cooperative Program sanitary requirements should be applied to all growing areas and all shellfish harvesters to insure that all shellfish available to certified dealers have been produced and harvested under acceptable sanitary conditions. It is also important that the shell stock be protected against contamination during the period between harvesting and delivery to the certified shipper.

3. Intrastate Sale of Market Shellfish.—Sanitary standards for intrastate shellfish shippers should be substantially equivalent to those of the Cooperative Program.

Public-health explanation.—States may accept lower sanitary standards for shellfish sold intrastate than are required by the Cooperative Program. However, it has been found that small intrastate shippers may at times sell their product to interstate shippers if demand exceeds the supply of shellfish available to the latter. Because of the possibility that such substandard shellfish might be shipped interstate, the 1954 National Conference on Shellfish Sanitation recommended that Cooperative Program standards be applied to all shellfish production and processing (1). The 1958 Shellfish Sanitation Workshop also strongly recommended the use of substantially equivalent standards for intra- and inter-state shellfish shippers (3).

Section B

LABORATORY PROCEDURES

1. Bacteriological.—American Public Health Association Recommended Procedures for the Examination of Sea Water and Shellfish shall be followed in the collection and transportation of samples of shellfish and shellfish waters for bacteriological examination and in the laboratory examination of such samples.¹

Satisfactory compliance.—This item will be satisfied when current American Public Health Association Recommended Procedures for the Examination of Sea Water and Shellfish are followed in the bacteriological examination of shellfish and shellfish waters.

Public-health explanation.—Experience with the bacteriological examination of shellfish and shellfish growing waters has indicated that minor differences in laboratory procedures or techniques will cause wide variations in the results. Variations in results may also be caused by improper handling of the sample during collection or transportation to the laboratory (10). The American Public Health Association Recommended Procedures for the Examination of Sea Water and Shellfish, which are revised periodically, offer a reliable way of minimizing these variations. (Cooperative Program required use of a standard procedure for the bacteriological examination of shellfish and shellfish waters should not discourage laboratories from working on new methods of sample handling or analysis.)

2. Toxicological.—A recognized procedure shall be used in the assay for paralytic shellfish poison.

Satisfactory compliance.—This item will be satisfied when current Association of Of-

ficial Agricultural Chemists official methods are followed in the bioassay for paralytic shellfish poison.

Public-health explanation.—It has been demonstrated that significant variations in bioassay results will be caused by minor changes in procedures. If reliable results are to be obtained it is essential that the test procedures be standardized and that variations due to use of strains of mice be minimized (11). The official procedure for the bioassay for paralytic shellfish poison adopted by the Association of Official Agricultural Chemists minimizes these variations (66). A chemical test for paralytic shellfish poison has also been developed (12).

3. Chemical and Physical.—Standard laboratory methods shall be used for all salinity, radionuclide, and other chemical and physical determinations made on shellfish or shellfish waters in conjunction with Cooperative Program activities. Results shall be reported in standard units.

Satisfactory compliance.—This item will be satisfied when—

a. Chemical and physical measurements on shellfish and shellfish waters are made in accord with accepted laboratory techniques.

b. Results of all chemical and physical determinations are expressed in standard units. (For example, salinity should be expressed in parts per thousand rather than hydrometer readings.)

Public-health explanation.—Standardized laboratory procedures are most apt to produce results in which the State shellfish control agency can have confidence, and facilitate comparative evaluation of data. The need for adherence to standardized procedures should not discourage laboratories from experimental use of nonstandard methods.

¹ Material which may be useful in interpretation of results of bacteriological examination of shellfish is contained in appendix A.

Section C

GROWING AREA SURVEY AND CLASSIFICATION

1. Sanitary Surveys of Growing Areas.—

A sanitary survey shall be made of each growing area prior to its approval by the State as a source of market shellfish or of shellfish to be used in a controlled purification or relaying operation. The sanitary quality of each area shall be reappraised at least biennially and, if necessary, a resurvey made. Ordinarily, resurveys will be much less comprehensive than the original survey since it will only be necessary to bring the original information up to date. Records of all original surveys and resurveys of growing areas shall be maintained by the State shellfish control agency, and shall be made available to Public Health Service review officers upon request.

Satisfactory compliance.—This item will be satisfied when—

a. A sanitary survey has been made of each growing area in the State prior to initial approval of interstate shipments of shellfish from that area. A comprehensive sanitary survey shall include an evaluation of all sources of actual or potential pollution on the estuary and its tributaries, and the distance of such sources from the growing areas; effectiveness and reliability of sewage treatment works; the presence of industrial wastes or radionuclides which would cause a public-health hazard to the consumer of the shellfish; and the effect of wind, stream flow, and tidal currents in distributing polluting materials over the growing area.² The thoroughness with which each element must be investigated varies greatly and will be determined by the specific conditions in each growing area.

b. The factors influencing the sanitary quality of each approved shellfish growing area are reappraised at least biennially.³ A

² In making the sanitary survey consideration should be given to the hydrographic and geographic characteristics of the estuary, the bacteriological quality of the growing area water and bottom sediments, and the presence and location of small sources of pollution, including boats, which might contribute fresh sewage to the area.

complete resurvey should be made of each growing area in an approved category at least once every ten years; however, data from original surveys can be used when it is clear that such information is still valid.

c. A file which contains all pertinent sanitary survey information, including the dates and results of preceding sanitary surveys is maintained by the State shellfish control agency for each classified shellfish area.

Public-health explanation.—The positive relationship between sewage pollution of shellfish growing areas and enteric disease has been demonstrated many times (13) (14) (15) (16) (17) (18). However, epidemiological investigations of shellfish-caused disease outbreaks have never established a direct numerical correlation between the bacteriological quality of water and the degree of hazard to health. Investigations made from 1914 to 1925 by the States and the Public Health Service—a period when disease outbreaks attributable to shellfish were more prevalent—indicated that typhoid fever or other enteric disease would not ordinarily be attributed to shellfish harvested from water in which not more than 50 percent of the one cc. portions of water examined were positive for coliforms,⁴ *provided the areas were not subject to direct contamination with small amounts of fresh sewage which would not ordinarily be revealed by the bacteriological examination.*

Following the oyster-borne typhoid outbreak during the winter of 1924–25 in the United States (19) the cooperative shellfish certification program was initiated by the States, the Public Health Service, and the shellfish industry (9). Water quality criteria were then stated as:

³ The purpose of this reappraisal is to determine if there have been changes in stream flow, sewage treatment, populations, or other similar factors which might result in a change in the sanitary quality of the growing area. The amount of field work associated with such a reappraisal will depend upon the area under consideration and the magnitude of the changes which have taken place.

⁴ An MPN of approximately 70 per 100 ml.

a. The area is sufficiently removed from major sources of pollution so that the shellfish would not be subjected to fecal contamination in quantities which might be dangerous to the public health.

b. The area is free from pollution by even small quantities of fresh sewage. The report emphasized that bacteriological examination does not, in itself, offer conclusive proof of the sanitary quality of an area.

c. Bacteriological examination does not ordinarily show the presence of the coli-aerogenes group of bacteria in 1 cc. dilutions of growing area water.

The reliability of this three-part standard for evaluating the safety of shellfish producing areas is evidenced by the fact that no major outbreaks of typhoid fever or other enteric disease have been attributed to shellfish harvested from waters meeting the criteria since they were adopted in the United States in 1925. Similar water quality criteria have been in use in Canada with like results. The available epidemiological and laboratory evidence gives little idea as to the margin of safety, but it is probably considerable as indicated by the virtual absence of reported shellfish caused enteric disease over a comparatively long period of time (18) (20) (21).

The purpose of the sanitary survey is to identify and evaluate those factors influencing the sanitary quality of a growing area and which may include sources of pollution, potential or actual; the volume of dilution water; the effects of currents, winds and tides in disseminating pollution over the growing areas; the bacterial quality of water and bottom sediments; die-out of polluting bacteria in the tributaries and the estuary; bottom configuration; and salinity and turbidity of the water. Sources of pollution include municipal sewage discharged into the estuary or inflowing rivers; sewage brought into the estuary by tides or currents; surface run-off from polluted areas; industrial wastes; and discharges from pleasure craft, fishing boats, naval vessels, and merchant shipping.

Bacteriological examination of the growing waters is an important component of the

sanitary survey. In many instances the bacteriological and related salinity data will also provide valuable information on the hydrographic characteristics of an area.⁵

Ideally, a large number of water samples for bacteriological examination should be collected at each station. However, in most instances this is not practical because of time and budget limitations, and accordingly only a limited number of samples can be collected. Therefore, sampling stations should be chosen which will provide a maximum of data, and which will be representative of the bacteriological quality of water in as wide an area as possible. Sample collection should be timed to represent the most unfavorable hydrographic and pollution conditions since shellfish respond rapidly to an increase in the number of bacteria in their environment (25) (26).

There is no specified minimum number of sampling stations, frequency of sampling, or total number of samples. Sampling results obtained over a period of several years can be used as a block of data provided at least 15 samples have been collected from each of a representative number of stations along the line separating approved from restricted growing areas and there have been no adverse changes in hydrographic or sanitary conditions. Only occasional bacteriological samples are necessary from areas which are shown to be free from pollution.

Experience with the shellfish certification program indicates a tendency to omit or de-emphasize some components of the sanitary survey unless a central State file of all shell-

⁵ Bacteria in an unfavorable environment die out in such a way that following an initial lag period there is a large percentage decline during the first few days. Descriptions of studies on bacterial die-out have been published by Greenberg (22) and Pearson (23). Die-off has also been investigated by the Public Health Service Shellfish Sanitation Laboratory at Woods Hole, Mass., and Pensacola, Fla. Application of this principle may be helpful in predicting the quantity of pollution which will reach an area, and in establishing objective effluent quality criteria (24).

⁶ In connection with the evaluation of sampling results, it should be noted that the MPN determination is not a precise measure of the concentration of bacteria (4). Thus, in repeated sampling from waters having a uniform density of bacteria varying MPN estimates will be obtained. The use of the tolerance factor 3.3 (applicable only to 5 tube decimal dilution MPN's) is one method of recognizing this variation. For example, in a body of water in which the median concentration of coliform bacteria is 70 per 100 ml., 95% of observed MPN's will be between 20 and 230 per 100 ml.; i. e., $70/3.3=21$ and $70 \times 3.3=230$.

fish sanitary surveys, reappraisals, and re-surveys is maintained. This is particularly true where responsibility for shellfish sanitation is divided between two or more State agencies. Maintenance of a central State file for all shellfish sanitary survey information will also simplify the endorsement appraisal of State programs by the Public Health Service and will help prevent loss of old data which may be useful in evaluating the sanitary quality of an area.

Periodic reappraisals of the sanitary quality of shellfish producing areas are necessary to determine that environmental conditions are such that the original conclusions are still valid. A *resurvey* should be made if the *reappraisal* shows a significant change.

2. Classification of Growing Areas.—All coastal waters shall be classified as to their public health suitability for the harvesting of market shellfish. Classification criteria are described in sections C-3, C-4, C-5, C-6, and C-7 of this manual. Except in emergency any upward revision of an area classification shall be preceded by a sanitary survey, resurvey, or reappraisal. A written analysis of the data justifying the reclassification shall be made a part of the area file.

Satisfactory compliance.—This item will be satisfied when—

a. All coastal waters in the State are correctly designated with one of the following classifications on the basis of sanitary survey information: *Approved*; *conditionally approved*; *restricted*; or *prohibited*.⁷

b. Area classifications are revised whenever warranted by survey data.

c. Classifications are not revised upward without at least a file review, and there is a written record of such review in the area file maintained by the State shellfish control agency.

d. All coastal areas which have not been subjected to sanitary surveys shall be automatically classified as *prohibited*.

Public-health explanation.—The probable presence or absence of pathogenic organisms in shellfish waters is of the greatest importance in deciding how shellfish obtained from

an area may be used. All coastal waters should thus be classified according to the information developed in the sanitary survey. Classification should not be revised upward without careful consideration of available data. Areas should be reclassified whenever warranted by existing data. A written justification for the reclassification simplifies Public Health Service appraisal of State programs.

A hypothetical use of the four recognized area classifications is shown in figure 1. This idealized situation depicts an estuary receiving sewage from two cities, "A" and "B." City "A" has complete sewage treatment including chlorination of effluent. City "B" has no sewage treatment. The estuary has been divided into five areas, designated by roman numerals, on the basis of sanitary survey information:

Approved

Area I. The sanitary survey indicates that sewage from cities "A" and "B" (even with the "A" sewage plant not functioning) would not reach this area in such concentration as to constitute a public-health hazard. The median coliform MPN of the water is less than 70/100 ml. The sanitary quality of the area is independent of sewage treatment at city "A."

Conditionally Approved

Area II. This area is of the same sanitary quality as area I; however, the quality varies with the effectiveness of sewage treatment at city "A." This area would probably be classified *prohibited* if city "A" had not provided sewage treatment.

Restricted

Area III. Sewage from "B" reaches this area, and the median coliform MPN of water is between 70 and 700 per 100 ml. Shellfish may be used only under specified conditions.

Prohibited

Area IV. Direct harvesting from this area is prohibited because of raw sewage

⁷ Closures may also be based on presence of paralytic shellfish poison.

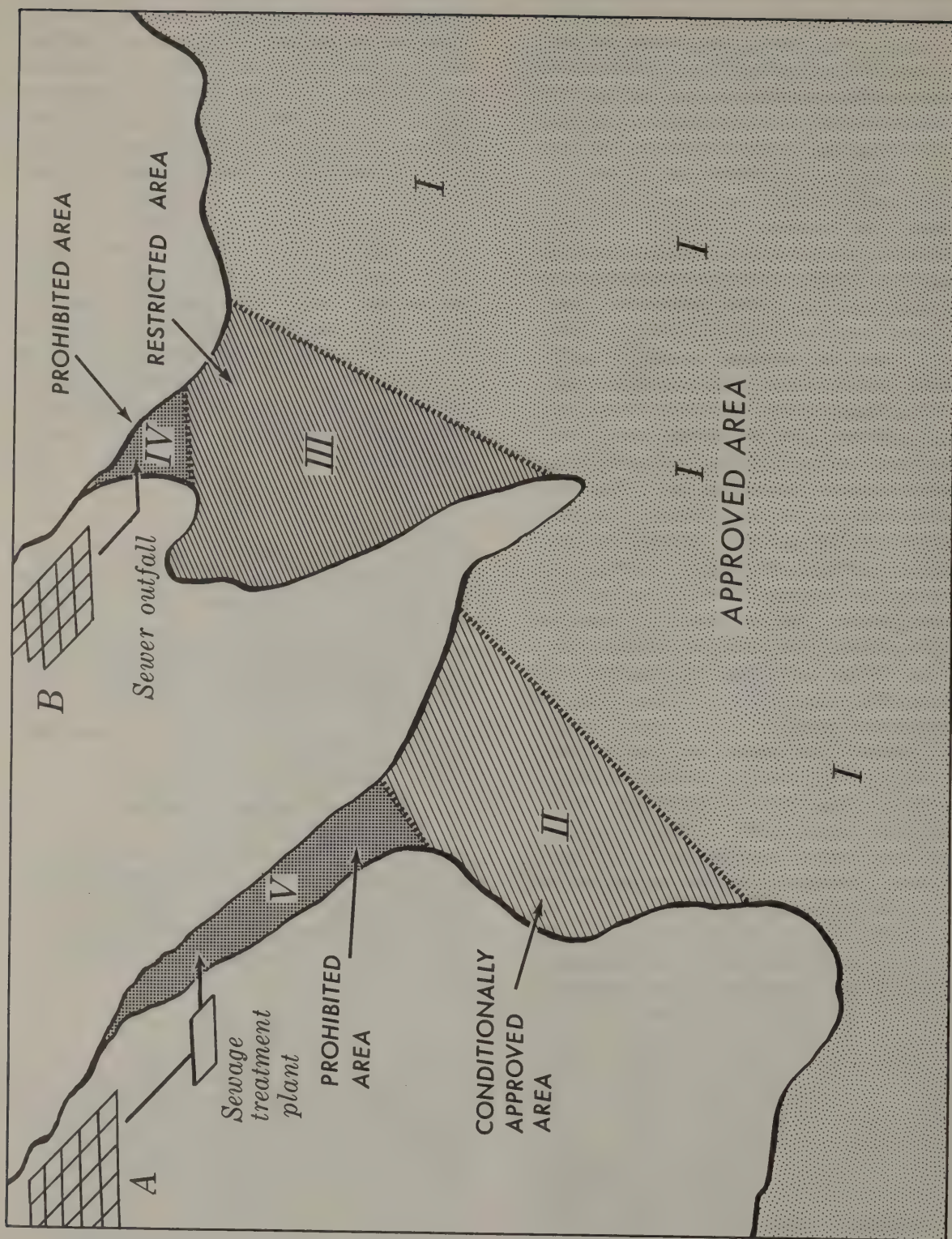


FIGURE 1.

from "B." The median coliform MPN of water may exceed 700/100 ml.

Area V. Direct harvesting from this area is prohibited because of possible failure of the sewage treatment plant. Closure is based on need for a safety factor rather than coliform content of water or amount of dilution water.

3. Approved Areas.—Growing areas may be designated as *approved* when: (a) the sanitary survey indicates that pathogenic microorganisms, radionuclides, and/or harmful industrial wastes do not reach the area in dangerous concentration, and (b) this is verified by laboratory findings insofar as possible. Shellfish may be taken from such areas for direct marketing.

Satisfactory compliance.—This item will be satisfied when the three following criteria are met:

a. The area is not so contaminated with fecal material that consumption of the shellfish might be hazardous, and

b. The area is not so contaminated with radionuclides or industrial wastes that consumption of the shellfish might be hazardous (see section C, item 7, regarding paralytic shellfish poison in shellfish growing areas), and

c. The coliform median MPN of the water does not exceed 70 per 100 ml., and not more than 10 per cent of the samples ordinarily exceed an MPN of 230 per 100 ml. for a 5-tube decimal dilution test (or 330 per 100 ml., where the 3-tube decimal dilution test is used) in those portions of the area most probably exposed to fecal contamination during the most unfavorable hydrographic and pollution conditions. (Note: This concentration might be exceeded if less than 8 million cubic feet of a coliform-free dilution water are available for each population equivalent (*coliform*) of sewage reaching the area.) The foregoing limits need not be applied if it can be shown by detailed study that the coliforms are not of direct fecal origin and do not indicate a public health hazard (19) (20).⁸

⁸ This MPN value is based on a typical ratio of coliforms to pathogens and would not be applicable to any situation in which an abnormally large number of pathogens might be present. Consideration must also be given to the possible presence of industrial or agricultural wastes in which there is an atypical coliform to pathogen ratio (30).

Public-health explanation.—A review of epidemiological investigations of disease outbreaks attributable to the consumption of raw shellfish reveals that two general situations prevail⁹ insofar as pollution of growing or storage areas are concerned.

(1) Gross sewage contamination of a growing or wet storage area. (A report of a 1910 outbreak of typhoid fever involving 45 persons notes that raw sewage from a city with a population of 30,000 was discharged only a few hundred feet away from clam beds and floats (27) (28). In 1947 a case of typhoid fever was attributed to clams harvested 200 yards from the outlet of a municipal sewage treatment plant (29). In the latter case, the coliform MPN of the harbor water exceeded 12,000 per 100 ml. and the area had been posted as closed to shellfish harvesting.)

(2) Chance contamination of a growing or wet storage area by fresh fecal material which may not be diffused throughout the entire area (14) (16) (17) (19) and therefore not readily detectable by ordinary bacteriological procedures. The possibility of chance contamination was noted by Dr. Gurion in his report on a 1902 typhoid outbreak, and who is quoted in Public Health Bulletin No. 86, as "there is a zone of pollution established by the mere fact of the existence of a populated city upon the banks of a stream or tidal estuary which makes the laying down of oysters and clams in these waters a pernicious custom if persisted in, because it renders these articles of food dangerous at times, and always suspicious". The 1956 outbreak of infectious hepatitis in Sweden (691 cases) attributed to oysters which were contaminated in a wet storage area is an example of such contamination (16). Similarly in 1939, 87 cases of typhoid were attributed to fecal contamination of a storage area by a typhoid carrier (14).

It is well established that shellfish from water having a median coliform MPN not

⁹ There is a third general consideration in which shellfish may be contaminated through mishandling. This is not related to growing area sanitation and is considered in part II of this manual.

exceeding 70 per 100 ml.⁸ and which is also protected against chance contamination with fecal material, will not be involved in the spread of disease which can be attributed to initial contamination of the shellfish. This is not surprising since a water MPN of 70/100 ml. is equivalent to a dilution ratio of about 8 million cubic feet of coliform-free water per day for the fecal material from each person contributing sewage to the area. This tremendous volume of water is available in shellfish growing areas through tidal action which is constantly bringing unpolluted water into the area.⁸

Areas which are approved for direct market harvesting of shellfish which will be eaten raw must necessarily meet one general test; i.e., sewage reaching the growing area must be so treated, diluted, or aged that it will be of negligible public-health significance. This implies an element of time and distance to permit the mixing of the sewage or fecal material with the very large volume of diluting water and for a major portion of the microorganisms to die out. Studies of the natural die-off of microorganisms in an unfavorable marine environment have been summarized by Greenberg (22).

The effectiveness of sewage treatment processes must be considered in evaluating the sanitary quality of a growing area since the bacterial content of the effluent will be determined by the degree of treatment which is obtained (2). The results of bacteriological sampling must also be correlated with sewage treatment plant operation, and evaluated in terms of the minimum treatment which can be expected with a realization of the possibility of malfunctioning, overloading, or poor operation.

The presence of radionuclides in growing area waters may also have public-health significance since shellfish, along with other marine organisms, have the ability to concentrate such materials (31) (32) (33) (34). The degree to which radioisotopes will be concentrated depends upon the species of shellfish and the specific radioisotope. For example, it has been reported that the East-

ern oyster has a concentration factor of 17,000 for Zn⁶⁵ whereas the concentration factor for Sr⁸⁹ is approximately unity (31). The distribution of the radioisotope in the shellfish and the biological half-life are also variable. Sources of radioactive materials include fall-out, industrial wastes, and nuclear reactors. Limiting maximum permissible concentrations of radioactive materials expressed in terms of specific radioisotopes and unidentified mixtures in water and food have been established (35) (36). The current standard should be consulted in evaluating the public-health significance of detected radioactivity in market shellfish.

The bacterial quality of active shellfish will ordinarily be directly proportional to the bacterial quality of the water in which they grew; however, considerable variation in individual determinations may be expected. The coliform MPN's of the shellfish usually exceed those of the overlying water because shellfish filter large quantities of water to obtain food, thereby concentrating the suspended bacteria. This relationship will depend upon the shellfish species, water temperature, presence of certain chemicals, and varying capabilities of the individual animals. (See appendix A.)

4. Conditionally Approved Areas.—The suitability of some areas for harvesting shellfish for direct marketing is dependent upon the attainment of an established performance standard by sewage treatment works discharging effluent, directly or indirectly, to the area. In other cases the sanitary quality of an area may be affected by seasonal population, or sporadic use of a dock or harbor facility. Such areas may be classified as *conditionally approved*.

State shellfish control agencies shall establish *conditionally approved* areas only when satisfied that (a) all necessary measures have been taken to insure that performance standards will be met, and (b) that precautions have been taken to assure that shellfish will not be marketed from the areas subsequent to any failure to meet the performance standards and before the shellfish can purify themselves of polluting micro-organisms.

⁸ See footnote 8 on page 13.

Satisfactory compliance.—This item will be satisfied when—

a. The water quality requirements for an *approved* area are met at all times while the area is approved as a source of shellfish for direct marketing.

b. An operating procedure for *each conditionally approved* area is developed jointly by the State shellfish control agency, local agencies, including those responsible for operation of sewerage systems, and the local shellfish industry. The operating procedure should be based on an evaluation of each of the potential sources of pollution which may affect the area. The procedure should establish performance standards, specify necessary safety devices and measures, and define inspection and check procedures. (These procedures are described in more detail in the following public-health explanation.)

c. A closed safety zone is established between the *conditionally approved* area and the source of pollution to give the State agency time to stop shellfish harvesting if performance standards are not met.

d. Boundaries of *conditionally approved* areas are so marked as to be readily identified by harvesters.

e. Critical sewerage system units are so designed, constructed, and maintained that the chances of failure to meet the established performance standards due to mechanical failure or overloading are minimized.

f. There is a complete understanding of the purpose of the *conditionally approved* classification by all parties concerned, including the shellfish industry. Successful functioning of the concept is dependent upon the wholehearted cooperation of all interested parties. If such cooperation is not assured the State should not approve the area for direct harvesting of market shellfish.

g. Any failure to meet the performance standards is immediately reported to the State shellfish control agency by telephone or messenger. In some instances States may find it desirable to delegate the authority for closing a *conditionally approved* area to a representative of the agency located in the immediate area.

h. The State immediately closes *conditionally approved* areas to shellfish harvesting following a report that the performance standards have not been met. The area shall remain closed until the performance standards can again be met plus a length of time sufficient for the shellfish to purify themselves so that they will not be a hazard to the public health. (See section D-1, "Relaying," for information on the length of time required for self-purification of shellfish.)

i. The State shellfish control agency makes at least two evaluations during the shellfish harvesting season of each *conditionally approved* area including inspection of each critical unit of the sewerage system to determine the general mechanical condition of the equipment, the accuracy of recording devices, and the accuracy of reporting by the operating agency.

j. If it is discovered that failure to meet performance standards have not been reported by the operating agency, or if the performance standards are not met, the area shall immediately revert to a *restricted* or *prohibited* classification.

k. All data relating to the operation of a *conditionally approved* area, including operation of sewerage systems, are maintained in a file by the State shellfish control agency.

Public-health explanation.—The *conditionally approved* classification is designed primarily to protect shellfish growing areas in which the water quality might undergo a significant adverse change within a short period of time.¹⁰ The change might result from overloading or mechanical failure of a sewage treatment plant, or bypassing of sewage at a lift station.

Water quality in many growing areas in the more densely populated sections of the country is, to some degree, dependent upon the operation of sewage treatment plants. For example, the boundaries of an approved shellfish area might be determined during a period when a tributary sewage treatment plant is operating at a satisfactory level. If

¹⁰ A natural disaster may also cause many sewage treatment plants to be out of service for an extended period of time. The *conditionally approved* area concept is not ordinarily concerned with such emergency situations.

there is some interruption in treatment it follows that there will be some degradation in water quality in the growing area, which may justify a relocation of the boundaries. The degree of relocation would depend upon such items as the distance between the pollution source and the growing area, hydrography, the amount of dilution water, and the amount of pollution.

The concept is also applicable to other situations in which there may be a rapid or seasonal change in water quality. Examples of such situations include—

a. A growing area adjacent to a resort community. During the summer months the community might have a large population which might have an adverse effect on water quality. However, during the winter when there are few people in the community the water quality might improve sufficiently to allow approval of the area. In some States this is known as a seasonal closure.

b. A protected harbor in a sparsely settled area might provide anchorage for a fishing fleet several months a year. When the fishing fleet is in, the harbor water would be of poor sanitary quality; however, during the remainder of the year the quality of the harbor water might be satisfactory. The area would be approved for shellfish harvesting only when the fishing fleet is not using the harbor.

c. The water quality in an area fluctuates with the discharge of a major river. During periods of high runoff the area is polluted because of decreased flow time in the river. However, during periods of low runoff the area might be of satisfactory quality and thus be approved for shellfish harvesting.

The establishment of *conditionally approved* areas might be considered whenever the potential for sewage contamination is such that the limiting water quality criteria for an *approved* area might be exceeded in less than one week due to a failure of sewage treatment, or other situations as described above.

The first step in determining whether an area should be placed in the *conditionally approved* classification is the evaluation of the potential sources of pollution in terms of their effect on water quality in the area. Po-

tential sources of pollution include the following:

(1) Sewage treatment plants.

(a) By-passing of all or part of sewage because of mechanical or power failure, hydraulic overloading, or treatment overloading.

(b) Reduced degree of treatment due to operational difficulties or inadequate plant.

(2) Sewage lift stations.

(a) By-passing during periods of maximum flow due to inadequate capacity.

(b) By-passing because of mechanical or power failure.

(3) Interceptor sewers or underwater outfalls.

(a) Exfiltration due to faulty construction.

(b) Leakage due to damage.

(4) Other sources of pollution.

(a) Sewage from merchant or naval vessels.

(b) Sewage from recreation use of area.

The second step in establishment of a *conditionally approved* area is the evaluation of each source of pollution in terms of the water quality standards to be maintained, and the formulation of performance standards for each installation having a significant effect on the sanitary quality of the area. Examples of performance standards might include:

(1) Bacteriological quality of effluent from sewage treatment plants. This might be stated in terms of chlorine residual if the bacteriological quality of the effluent can be positively related to chlorine residual. The following is an example of a performance standard (37): "The median coliform MPN, in any one month, shall not exceed 500 per 100 ml., based on not less than 16 composite samples per month, and not more than 10 percent of the samples shall have an MPN in excess of 10,000 per 100 ml. Determinations of the chlorine residual of the effluent should be made hourly and recorded in the permanent plant records."

(2) Total quantity of sewage which can be discharged from any given unit, or from a combination of units, without causing the basic water quality standards to be exceeded.

(3) Amount of shipping in the area and the amount of sewage which can be expected.

Design criteria which may be useful in formulating an opinion on the quantity of sewage which can be discharged into an area without exceeding the desired water quality standards include: Population equivalent (*coliform*) of sewage; predicted survival of coliform in sea water, effectiveness of chlorination, and the total quantity of clean dilution water in an area. Results of many studies on the survival of bacteria in sea water have been summarized in *An Investigation of the Efficacy of Submarine Outfall Disposal of Sewage and Sludge*; Publication No. 14, California State Water Pollution Control Board, 1956.

The mechanical equipment at critical sewage treatment or pumping units should be such that interruptions will be minimized. Wherever possible operations should be automatically recorded on charts. Examples of the requirements which might be imposed, depending upon the importance of the unit in terms of water quality, include:

(1) Ample capacity for storm flows. (Storm water should ordinarily be excluded from the sanitary system.)

(2) Standby equipment to insure that treatment or pumping will not be interrupted because of damage to a single unit or to power failure.

(3) Instrumentation of pumps and equipment to allow the regulatory agency to determine that performance standards have been met. Examples include:

(a) Recording scales to indicate rate of chlorine use. Chlorine flow can be integrated with hydraulic flow to establish a ratio.

(b) Liquid level recording gauges in overflow channels of sewage treatment plants and wet wells of lift stations to indicate when overflow takes place. Charts should be dated and initialed

by the operator. Gauges should be calibrated so that discharge can be estimated.

(c) Automatic devices to warn of failure or malfunctioning at self-operated pumping stations or treatment plants.

(4) The effect of storm sewage can be calculated by multiplying the total estimated flow by the observed coliform content. The result can be expressed in terms of population equivalents (*coliform*).

Design and operation of equipment should be such that closure provisions should not have to be invoked more than once per year under ordinary circumstances.

A closed safety area should be interposed between the *conditionally approved* area and the source of pollution. The size of such area should be based on the total time it would take for the operating agency to detect a failure, notify the State shellfish control agency, and for the latter agency to stop shellfish harvesting. It is recommended that the area be of such size that the flow time through the safety area be at least twice that required for the notification process to become effective. Due consideration should be given to the possibility that closure actions might be necessary on holidays or at night.

The type of marking which will be required for *conditionally approved* areas will vary from State to State depending upon the legal requirements for closing an area.

The length of time a *conditionally approved* area should be closed following a temporary closure will depend upon several factors including the species of shellfish, water temperature, purification rates, presence of silt or other chemicals that might interfere with the physiological activity of the shellfish, and the degree of pollution of the area. (See section D-1 of this manual for additional information on the natural purification of shellfish.)

5. Restricted Areas.—An area may be classified as *restricted* when a sanitary survey indicates a limited degree of pollution which would make it unsafe to harvest the shellfish for direct marketing. Alternatively the States may classify such areas as *prohibited*. (See section C-6, this manual.) Shellfish

from such areas may be marketed after purifying or relaying as provided for in section D.

Satisfactory compliance.—This item will be satisfied when the following water quality criteria are met in areas designated by States as *restricted*.^{11 12}

a. The area is so contaminated with fecal materials that direct consumption of the shellfish might be hazardous, and/or

b. The area is not so contaminated with radionuclides or industrial wastes that consumption of the shellfish might be hazardous, and/or

c. The coliform median MPN of the water does not exceed 700 per 100 ml. and not more than 10 percent of the samples exceed an MPN of 2,300 per 100 ml. in those portions of the areas most probably exposed to fecal contamination during the most unfavorable hydrographic and pollution conditions. (Note: this concentration might be exceeded if less than 800,000 cubic feet of a coliform-free dilution water are available for each population equivalent (*coliform*) of sewage reaching the area.)

d. Shellfish from *restricted* areas are not marketed without controlled purification or relaying.

Public-health explanation.—In many instances it is difficult to draw a clear line of demarcation between polluted and non-polluted areas. In such instances the State may, at its option, classify areas of intermediate sanitary quality as *restricted* and authorize the use of the shellfish for relaying, or controlled purification.

6. Prohibited Areas.—An area shall be classified *prohibited* if the sanitary survey indicates that dangerous numbers of pathogenic micro-organisms might reach an area. The taking of shellfish from such areas for direct marketing shall be prohibited. Relaying or other salvage operations shall be carefully supervised to insure against polluted shellfish entering trade channels. Coastal areas which have not been subjected to sanitary surveys

shall be automatically classified as *prohibited*.

Satisfactory compliance.—This item will be satisfied when:

a. An area is classified as *prohibited* if a sanitary survey indicates either of the following degrees of pollution:

(1) The area is so contaminated with radionuclides or industrial wastes that consumption of the shellfish might be hazardous and/or

(2) The median coliform MPN of the water exceeds 700 per 100 ml. or more than 10 percent of the samples have a coliform MPN in excess of 2,300 per 100 ml. (Note: This concentration might be reached if less than 800,000 cubic feet of a coliform-free dilution water are available for each population equivalent (*coliform*) of sewage reaching the area.)

b. No market shellfish are taken from *prohibited* areas except by special permit as described in section D.

c. Coastal areas in which sanitary surveys have not been made shall be automatically classified as *prohibited*.

Public-health explanation.—The positive relationship between enteric disease and the eating of raw or partially cooked shellfish has been outlined in section C-1. Prevention of the interstate transport of shellfish containing sufficient numbers of pathogenic micro-organisms to cause disease is a primary objective of the Cooperative Program. Therefore, areas containing dangerous concentrations of micro-organisms of fecal origin, or areas which may be slightly contaminated with fresh fecal discharges, should not be approved as a source of shellfish for direct marketing.

7. Closure of Areas Due to Paralytic Shellfish Poison.—The State shellfish control agency shall regularly collect and assay representative samples of shellfish from growing areas where paralytic shellfish poison is likely to occur. If the poison content reaches 80 micrograms per 100 grams of the edible portions of raw shellfish meat, the area shall be closed to the taking of the species of shellfish in which the poison has been found.¹³ The

¹¹ It is not mandatory that States use this classification. Areas not meeting the *approved* classification may be closed to all harvesting for direct marketing.

¹² Routine sanitary surveys and reappraisals of *restricted* areas shall be made on the same frequency as for *approved* areas. (See section C-1.)

¹³ This value is based on the results of epidemiological investigations of outbreaks of paralytic shellfish poison in Canada in 1954 and 1957 (38) (39).

harvesting of shellfish from such areas shall be controlled in accord with the recommendations of sections E-1 and E-2 of this manual.

The quarantine shall remain in effect until such time as the State shellfish control agency is convinced the poison content of the shellfish involved is below the quarantine level.¹⁴

Satisfactory compliance.—This item will be satisfied when—

a. The State shellfish control agency collects and assays representative samples of shellfish for the presence of paralytic shellfish poison from each suspected growing area during the harvesting season. (See section B-2 for assay methods.)

b. A quarantine is imposed against the taking of shellfish when the toxicity reaches 80 micrograms per 100 grams of the edible portion of raw shellfish.

Public-health explanation.—In some areas paralytic poison is collected temporarily by bivalve shellfish from free-swimming, one-celled marine plants on which these shellfish feed. The plants flourish seasonally when water conditions are favorable.

¹⁴ The provisions of this item apply only to shellfish which will be marketed as a fresh or frozen product as properly controlled heat processing will reduce the poison content of the shellfish.

Cases of paralytic poisoning, including several fatalities, resulting from poisonous shellfish have been reported from both the Atlantic and Pacific coasts. The minimum quantity of poison which will cause intoxication in a susceptible person is not known. Epidemiological investigations of paralytic shellfish poisoning in Canada have indicated 200 to 600 micrograms of poison will produce symptoms in susceptible persons and a death has been attributed to the ingestion of a probable 480 micrograms of poison. Investigations indicate that lesser amounts of the poison have no deleterious effects on humans. Growing areas should be closed at a lower toxicity level to provide an adequate margin of safety since in many instances toxicity levels will change rapidly (38) (39). It has also been shown that the heat treatment afforded in ordinary canning processes reduces the poison content of raw shellfish considerably.

A review of literature and research dealing with the source of the poison, the occurrence and distribution of poisonous shellfish, physiology and toxicology, characteristics of the poison, and prevention and control of poisoning has been prepared and is obtainable from the Public Health Service (40).

Section D

PREPARATION OF SHELLFISH FOR MARKETING

1. **Relaying.**—State shellfish control agencies may approve the intra or interstate transplanting of market shellfish from restricted or prohibited areas to approved areas subject to certain limitations. All phases of the operation shall be under the immediate supervision of responsible State(s) shellfish control or patrol agency(s). A memorandum of understanding shall be developed between the agencies responsible for the control of interstate relaying operations. (Shellfish may be transplanted from an *approved* area to another like area at any time without restriction due to sanitary reasons.)

Satisfactory compliance.—This item will be satisfied when—

a. Shellfish are not relaid from *restricted* or *prohibited* areas to *approved* areas without written permission of the State shellfish control agency.

b. All relaying operations are under the *immediate* supervision of the State shellfish control or patrol agency. Supervision shall be such that no polluted shellfish are marketed before the end of the approved relaying period. The supervising officer shall be authorized and equipped to enforce the State regulations on relaying; shall actually supervise the harvesting, transport and relaying of shellfish; and shall patrol the *approved* area during the period that shellfish are undergoing the cleansing process. However, direct supervision will not be necessary if relaying operations are carried out during a period when shellfish may not be marketed. A continuous record of water temperature, salinity, and any other critical variables must be maintained when it is known that the limiting values may be approached and when the minimum relaying periods are being used.

c. State permission to re-lay shellfish is given only to responsible persons unless the entire operation is under direct supervision by the State. Responsibility shall, when possible, be determined by the past record of the permit applicant. It is recommended that applicants be required to post performance bonds.

d. Relaid shellfish are held in the *approved* area for a period of time sufficient to allow them to cleanse themselves of polluting bacteria. (The time required for purification will be determined by water temperature, salinity, initial bacteriological quality and species of shellfish.)

e. Relaid shellfish are not harvested without written permission from the State shellfish control agency.

f. Areas designated for relaid shellfish are so located and marked that they may be readily identified by the harvesters and so that shellfish in any adjacent *approved* area will not be contaminated. (This requirement applies only to relaying during the harvesting season.)

g. Shellfish are not relayed intra or interstate from restricted or prohibited areas to *approved* areas without written permission of the State(s) shellfish control agency(s). (If shellfish are relayed interstate, a memorandum of agreement shall be developed outlining the control measures to be used.)

Public-health explanation.—Shellfish transplanted from a polluted to a clean environment will cleanse themselves of the polluting bacteria. This is a natural phenomenon resulting from the shellfish feeding processes. Bacteria in the body and shell cavity of the shellfish at the time of trans-

planting are either used as food or are ejected in feces or pseudofeces.

The length of time required for this cleansing process is influenced by many factors including original level of pollution, water temperature, presence of chemicals inhibitory to physiological activity of the shellfish, salinity, and varying capabilities of the individual animals. Advice on limiting water temperatures, either maximum or minimum, should be obtained from local marine biologists.

Investigations by marine biologists have confirmed that the physiological activities of the Eastern oyster (*Crassostrea virginica*) is reduced when the water temperature falls below a certain value. It has been found that the pumping rate of Eastern oysters is reduced at water temperatures below 50° F., and that most animals stop pumping at a water temperature of about 41° F. However, a few oysters show slight activity at temperatures approaching 32° F. (41) (42). This phenomenon was first noted by shellfish bacteriologists who found that Eastern oysters harvested from polluted areas during cold weather had coliform contents comparable with those of oysters harvested from clean areas during warmer weather (43) (44) (45).

Gibbard, *et al.* (46) investigating temperature-induced hibernation was unable to demonstrate coliforms in Eastern oysters within a few days after the water temperatures dropped to 32° F. The rapidity with which hibernating oysters become active when the water temperature rises above the threshold value was discussed by Wachter (47) in 1925 and was demonstrated by Gibbard, *et al.* (46). The latter investigator found that contamination accompanying a sudden two degree increase in water temperature from 41° to 43° F. was reflected in the oysters in one day.

Relaying operations must be carefully supervised by an official State agency since the shellfish may contain pathogenic microorganisms. Control must apply to all phases of the operation including initial harvesting, transportation, replanting, purification period, and final harvesting for marketing if the relaying area is adjacent to a restricted area

or to an area containing relaid shellfish which have not been released for harvesting.

2. Controlled Purification.—Shellfish from *restricted* or *prohibited* areas may be marketed after effective controlled purification. Purification shall be permitted only under the immediate supervision of the State shellfish control agency. Water used for purification shall be of high bacteriological quality and its physical and chemical properties shall be favorable to maximum physiological activity of the shellfish. Stringent precautions shall be taken by the State shellfish control agency to insure that shellfish harvested from *restricted* or *prohibited* areas are actually submitted to an effective purification process before marketing.

Purification of shellfish from *prohibited* areas shall not be approved by the State unless relaying is not practical for biological reasons, and no public-health hazard will result from the use of such shellfish.

Satisfactory compliance.—This item will be satisfied when:

a. The controlled purification system, including water treatment, has been demonstrated to be consistently effective for the species of shellfish being purified. Purification may be accomplished in either a natural body of water or in tanks. (In determining the effectiveness of the process at least the following factors shall be investigated: Water temperature, silt or turbidity, dissolved oxygen, presence of chemicals, and time required for purification.) The bacteriological quality of the purified shellfish shall be at least equal to shellfish of the same species harvested from local *approved* areas.

b. A purification plant operating procedure is developed and copies are supplied to the Public Health Service.

c. Water used for purification is obtained from an area meeting the physical and bacteriological requirements of an *approved* growing area, or in the case of treated water the bacteriological limits of the Public Health Service Drinking Water Standards (48) are met. If water is to be treated, it shall be obtained from an area meeting at least the sanitary requirements for a *restricted* area.

d. Water used for purification has chem-

ical and physical characteristics conducive to maximum physiological activity of the shellfish. (Consideration shall be given to the following: Presence of chemicals, turbidity, temperature, salinity and dissolved oxygen, and to the adequacy of the facilities of the operating agency for measuring these characteristics.)

e. Shellfish are freed of contamination and foreign material adhering to shells before purification.

f. Shellfish are culled before and after purification.

g. Purification plant operation is under the administrative control of the State shellfish control agency. Purification plants may be operated by agencies other than the State; however, insofar as the Cooperative Program is concerned, the State is responsible for satisfactory operation.

h. Laboratory control is maintained over the purification operation. Controls shall include at least the following: Daily or tidal-cycle bacteriological quality of water; final bacteriological quality for each lot of shellfish purified; and, when they are critical factors, hourly or continuous salinity determinations and tidal-cycle turbidity determinations.

i. The plant operator possesses a satisfactory knowledge of the principles of water treatment and bacteriology.

j. Animals, rodents, and unauthorized persons are excluded from the plant.

k. Plant employees fulfill the qualifications for a shucker as described in section B-28, part II of this manual.

l. The State has an effective system for assuring that shellfish harvested from *restricted* areas will be submitted to purification before marketing. Shellfish harvesting from *prohibited* areas for controlled purification shall be under the immediate supervision of the State.

m. Shellfish from *prohibited* areas are not subjected to purification unless the State shellfish control agency can show that relaying or depletion is not biologically feasible; and that no public-health hazard will result from the use of such shellfish.

Public-health explanation.—The ability of shellfish to purify themselves in clean water

was discovered early in the 1900's. The biological process is reasonably well understood and is described by Arcisz and Kelly (26) as follows:

"Purification is a mechanical process effected by the physiological functioning of the shellfish in clean water. When shellfish are feeding, the gills act as a filter to strain out some of the material that may be brought in by the water which passes through them. If this water contains sewage, some of the micro-organisms in it are entrapped in the mucus on the body of the shellfish and transferred to the alimentary tract. Some of these are perhaps utilized as food (49) and the others discharged from the body in the form of feces and pseudofeces. When shellfish from polluted water are placed in clean water, the sewage bacteria are eliminated from the shellfish, and, since no more are ingested, purification is accomplished."

The purification process has been investigated extensively in England and to a lesser extent in the United States and Canada (50) (51) (52). The technique is reliable if proper methods are used, and insofar as is known, is applicable to all commercial species of shellfish.

Many of the earlier investigators suggested that purification be accomplished in tanks using water which had been subjected to a treatment process (52). The analogy with water treatment was carried to the point of recommending a chlorine residual in the purification tanks. However, fishery biologists have shown that shellfish pumping is decreased or inhibited by even small quantities of chlorine (53) (54). The inhibitory effect of chlorinated-dechlorinated water on activity of Eastern oysters has been noted by the Public Health Service Shellfish Sanitation Laboratory.

Since purification depends upon the pumping rate of the shellfish, it is important that the water be free of chemicals or physical characteristics which might interfere with this activity. For example, silt or dissolved organic substances may influence the pumping rates of shellfish (55) (56). The relationship of water temperature to pumping rates has been mentioned previously.

Shellfish purification facilities have generally been considered to include holding tanks and water treatment facilities (57) (58); however, investigations in Canada and England have demonstrated that purification can be accomplished with relatively simple installations if the operation is supervised properly (59) (60) (61). Accordingly,

any purification process of *proven* effectiveness will be accepted by the Cooperative Program.

Administrative control of the purification process is necessary to insure that shellfish are properly washed and culled, are held for the required length of time, and that the purification water supply is properly controlled.

Section E

CONTROL OF HARVESTING FROM CLOSED AREAS

1. Identification of Closed Areas.—Shellfish harvesters shall be notified by direct notice and warning signs of areas closed to harvesting. Closed areas shall be so marked or described that they may be easily recognized by the harvesters. The measures necessary to accomplish delineation and notification will vary with the structure of the local shellfish industry and with the legal requirements of each State.

Satisfactory compliance.—This item will be satisfied when:

a. The boundaries of the closed areas are marked by fixed objects or landmarks in a manner which permits successful prosecution of any violations of the closed areas.

b. Shellfish harvesters are notified of the location of closed areas by publication or direct notification (such as registered mail) and by warning signs posted at points of access to each closed area. The method of notification and identification should permit the successful prosecution of persons harvesting shellfish from the closed areas. (The limiting of shellfish harvesting permits to specific areas is an alternative to posting or notification. Where such a system is used, posting will be required only for closed areas which contain market shellfish.)

Public-health explanation.—Previous sections of this manual have described the public-health reasons for limiting shellfish harvesting to areas free of contamination and paralytic shellfish poison. Methods have been described for the evaluation and classification of such areas. However, classification is not effective unless the State can prevent illegal harvesting of shellfish for direct marketing from these closed areas.

For the most part, control of illegal harvesting depends upon the police activities as described in section E-2. However, adequate delineation of the closed areas is fundamental to effective patrol.

The type of area identification will be determined by the structure of the local shellfish industry. Posting a warning sign is one method of informing shellfish harvesters that an area is closed to the taking of shellfish for public-health reasons. However, if the local shellfish industry is highly organized, with shellfish being harvested by only a few operators, identification may be accomplished by officially informing the harvesters that certain areas are closed to the taking of shellfish. It is recommended that the advice of the State's legal counsel be obtained to insure that the marking of closed areas and notifications to shellfish harvesters are such that illegal harvesting can be prosecuted successfully.

2. Prevention of Illegal Harvesting of Shellfish From Closed Areas.—Closed growing areas shall be patrolled by a State agency to prevent illegal harvesting. The patrol force shall be so equipped that its officers will be able to apprehend persons taking shellfish from closed areas.

Satisfactory compliance.—This item will be satisfied when—

a. There is no evidence that shellfish are being harvested from closed areas except by special permit as required to meet local conditions.

b. Closed shellfish growing areas are patrolled by representatives of an official agency, due consideration being given to night, weekend and holiday patrols. (States may delegate patrol activities to local organizations; however, responsibility for effective control will remain with the State insofar as the Cooperative Program is concerned.

c. Patrol forces are so equipped that persons observed in closed areas may be apprehended.

d. Complete records of patrol activities, including violations and court actions, are maintained in the central office of the State shellfish control or patrol agency. It will be

the responsibility of the State to include local patrol activities in these records. (See section A, subsection 2 (e) regarding monthly summaries of patrol activities.)

Public-health explanation.—The primary objective of the Cooperative Program is to insure that shellfish will be harvested only from areas which are free of dangerous concentrations of pathogenic micro-organisms, industrial or radioactive wastes, or paralytic shellfish poison.

Growing areas may be classified as to their public-health suitability for shellfish harvesting on the basis of information obtained by sanitary and toxicological surveys. However, if local shellfish harvesters are not convinced of the need for restrictions, shellfish may be harvested surreptitiously from the closed areas. Thus, patrol failure may nullify the public-health safeguards resulting from sanitary survey activities.

The fact that law prohibits the removal of shellfish from certain areas will deter most persons from attempting to harvest such shellfish provided they are aware of the law and of the areas which are closed. However, local public opinion may not support the need for such closures. In such cases favorable opinion can probably be developed only through an educational program or a locally demonstrated need such as an epidemic or outbreak of paralytic shellfish poisoning. There is also a minority element not concerned with the welfare of their customers and who, through ignorance or purpose, will attempt to circumvent the harvesting restrictions.

Patrols must, therefore, be directed against three classes of individuals; i. e., those who are ignorant of the law, those who believe the law is unjust or unreasonable, and those who have no regard for the law.

Several mechanisms for improving the effectiveness of patrols include educational programs to acquaint shellfish harvesters with the public-health reasons for the closures, elimination of the "temptation element" by depletion, and relaying or purification. Apprehension, prosecution, and punishment of violators is a final resort.

The type of patrol organization needed for any particular situation cannot be specified and is determined by the nature of areas to be patrolled, means of access, methods of harvesting, and species. Patrol equipment should be such that the officers can apprehend persons harvesting shellfish in a closed area. Necessary equipment might include patrol boats capable of operating in open waters; small, high-speed, readily transportable boats, or patrol automobiles. In many instances, two-way radio will be helpful in coordinating patrol activities.

Organization of the patrol activity must take into consideration the need for night, weekend, holiday, and surprise patrols. Either nuisance or continual patrol may be used depending on the nature of the area to be patrolled and the type of industry.

The adequacy of State laws as a basis for prosecution is an important component of this activity. Shellfish patrol will probably be ineffective if State laws are so written or interpreted that violators cannot be successfully prosecuted, or if penalties are so small that they are economically unimportant. The latter point may be important in an area where local public opinion does not support the need for the restriction.

3. Depletion of Closed Areas.—The State shellfish control or patrol agency shall supervise all depletion operations. All market-size shellfish and as many of the smaller size as can be gathered by reasonable methods shall be removed in the initial depletion operation. Depletion of each area shall be carried out at intervals to prevent the development of market-sized shellfish.

Satisfactory compliance.—This item will be satisfied when—

a. The State shellfish control or patrol agency exercises direct supervision over each depletion project including patrol of the area in which the shellfish are relaid. (See section D-1.)

b. All market shellfish and as many of the smaller size shellfish as can be gathered by reasonable methods are removed in the depletion operation.

c. Similar supervised depletion operations

are carried out at intervals to prevent development of market-sized shellfish in quantities which would make commercial harvesting economically practicable in the depleted areas.

Public-health explanation.—Complete re-

moval of shellfish from polluted to clean areas under appropriate precautions is the best safeguard against contaminated shellfish reaching the market. In some cases depletion may be more economical and effective than patrol of closed areas.

Appendix A

BACTERIOLOGICAL CRITERIA OF SHELLFISH AND SHELLFISH WATERS

The bacteriological examination of shellfish and shellfish growing waters is important in evaluating the sanitary quality of the aquatic environment; the sanitary quality of the shellfish as harvested; and, the changes in the sanitary quality of shellfish which occur during harvesting, shucking-packing, and marketing.

Section C of this manual outlines the procedures to be followed in evaluating the sanitary quality of an area. The objective data obtained through bacteriological examination of water samples is frequently indispensable in making such evaluations. However, the statistical and biological factors which influence bacteriological results must be recognized and understood if valid interpretation of results is to be obtained. The purpose of this appendix is to describe some of these factors as they are understood in 1958, and to mention some additional sources of information.

Shellfish will generally reflect the bacteriological quality of the water in which they have grown. However, this relationship is apparently not sufficiently constant to permit development of a uniform bacteriological standard which could be applied to all species of shellfish. For example, the soft shell clam (*Mya arenaria*) shows a consistently higher coliform content than do other species harvested from areas of like sanitary quality. Similarly, Eastern oysters harvested from South Atlantic and Gulf areas have a higher coliform content than those from the Middle Atlantic States.¹⁵ Seasonal variation is also pronounced (2). Table 1 demonstrates some of these variations.

¹⁵ The geographic subdivisions used coincide with those used in "Fishery Statistics of the United States," Fish and Wildlife Service, U. S. Department of the Interior.

The bacteriological quality of Eastern oysters harvested from the North and Middle Atlantic regions has been well investigated. Oysters as *harvested from approved areas* in these two regions should not ordinarily exceed a coliform MPN of 230 per 100 grams of shellfish meats although a few samples may approach or exceed 2,400 per 100 grams. If this latter value is exceeded in two consecutive samples, the State shellfish control agency should investigate to determine the probable cause.

Eastern oysters harvested from Chesapeake Bay, South Atlantic or Gulf States cannot be expected to meet routinely this standard of 230 per 100 grams even though harvested from water of like sanitary quality. This has been demonstrated in papers presented by Wilson and McClesky (62) and in the discussions at the 1956 and 1958 Shellfish Sanitation Workshops (2) (3).

The data contained in table II shows coliform contents of oysters (*Crassostrea virginica*) as harvested from areas of high sanitary quality on the Gulf coast.

On the basis of these data, oysters as *harvested* from Gulf areas might ordinarily have a coliform MPN of less than 2,400/100 grams. However, if this value is exceeded in two consecutive samples, the State shellfish con-

trol agency should undertake an investigation to determine the probable cause.

The bacteriological quality of hard clams (*Mercenaria mercenaria*) harvested from the New England and Middle Atlantic States has also been thoroughly investigated and the relationship seems well established (20). The findings of many State investigations are supported by Public Health Service Shellfish Sanitation Laboratory findings as shown in table I and which indicate the limiting coliform MPN's described for Eastern oysters from the New England and Middle Atlantic States are also applicable to hard clams harvested from similar areas. It is not known if similar bacterial results could be expected in hard clams harvested from Chesapeake Bay or South Atlantic States.

The bacteriology of soft shell clams (*Mya arenaria*) has also been investigated extensively in the Canadian Maritime Provinces and the New England and Middle Atlantic States. Data indicate that the limit of 230 cannot always be met in the case of soft clams harvested from approved areas and also that they will consistently have higher coliform MPN's than oysters or hard clams harvested from the same area (2). Preliminary investigations by the Maryland Department of Health indicate high coliform MPN's are

TABLE I
Average Shellfish Coliform MPN's for Various Applied Water MPN's

Water temperature	Species	Average shellfish MPN				
		Average water MPN's				
		20	70	250	700	1,000
Less than 8° C	Soft clams	380	930	2,300	4,800	6,200
	Hard clams	76	170	370	710	890
	Eastern oysters	26	64	160	340	450
8°-17° C	Soft clams	350	980	2,800	6,500	8,700
	Hard clams	120	320	840	1,900	2,500
	Eastern oysters	130	450	1,600	4,700	6,800
20°-23° C	Soft clams	375	833	1,900	3,600	4,500
	Hard clams	84	220	560	1,200	1,600
	Eastern oysters	37	190	960	3,600	5,800

Source: Bacteriological Examination as an Indicator of Sanitary Quality of Market Shellfish; C. B. Kelly; Proceedings, 1956 Shellfish Sanitation Workshop; Public Health Service, Washington, D. C., 1956.

Note: This data is based on experiments conducted at Woods Hole, Massachusetts, and may not be directly applicable to other regions.

found in soft clams harvested from the relatively warm water of Chesapeake Bay although the water quality is high and the areas are free of pollution (2). If a coliform MPN of 2,400/100 grams of soft-clam meats is exceeded in two successive samples of clams as harvested from approved areas the State shellfish control agency should investigate to determine the probable cause.

Studies on the bacteriological quality of mussels harvested from approved areas in the Canadian Maritime Provinces, New England, and the Middle Atlantic States indicate that the water to shellfish coliform relationships are similar to those described for soft shell clams. However, mussels may have somewhat higher MPN's than other shellfish species harvested from like areas.

It is emphasized that the foregoing bacteriological relationships apply only to shellfish at the time of removal from the growing areas and not to shell stock in storage for any appreciable period of time, or to shucked shellfish.

The influence of shucking, packing, and storage on the bacteriological quality of the shucked product has been recognized for years. One investigator has reported a positive correlation between plant sanitation or operating practices and the standard plate count of the product (63).

The Canadian Department of National Health and Welfare in 1950 pointed out that most of the United States shucked Eastern oysters sold in Canada had high coliform MPN's, high standard plate counts, or both. They reported that of 77 shipments of shucked Eastern oysters from the United States, 44.2 percent had a coliform MPN of less than 230 while 41.5 percent had coliform MPN's in excess of 16,000 per 100 grams. These results, when interpreted in accord with the 1946 *Manual of Recommended Practice for Sanitary Control of the Shellfish Industry* indicated the oysters were from a polluted source or had been grossly mishandled (64).

The significance of these results was discussed at the 1950 meeting of the Canadian Interdepartmental Shellfish Committee. On the basis of limited information on the sani-

TABLE II

Coliform MPN's of Oysters Sampled at Time of Harvesting

Coliform MPN per 100 gms. meats	Percent of Samples ¹ in Stated Group
Less than 230.....	63
Less than 2,400.....	90
Less than 24,000.....	97
Less than 160,000.....	100

¹ No. of Samples, 30.

Source: Proceedings, 1956 Shellfish Sanitation Workshop; *Bacteriological Examination as an Indicator of Sanitary Quality of Market Shellfish*, Kelly, C. B.

tary quality of similar shellfish sold on the American markets, it was decided to establish an interim bacteriological standard for shucked Eastern oysters sold in Canada. This standard was based on the premise that an increase in the bacteria content of market shellfish was unavoidable. Adoption of this interim standard by Canada resulted in a significant improvement in the sanitary quality of shucked oysters imported from the United States (2).

In 1950 the Public Health Service, in cooperation with the Government of Canada and several State health departments, investigated the bacteriological changes occurring during the processing and shipment of oysters from Chesapeake Bay to selected market areas. The study demonstrated a marked deterioration in bacteriological quality during shucking and shipment to market (65).

In 1954 and 1955 the Virginia Department of Health also investigated the changes in bacteriological quality which took place in oysters during shucking and packing (2). It was found that in the winter months about two-third of the samples of shell oysters had coliform MPN's of 230 or less per 100 grams. However, during the summer months few samples were under 230/100 grams and only 25 percent were below 2,400. On the "as packed" product during the winter months 10 percent of the samples had a coliform MPN of 230 or less, 50 percent were 2,400 or less, 75 percent were 9,000 or less, and 90 percent were below 24,000 (2).

The bacterial changes taking place during the harvesting and processing of oysters in

the Gulf States has been investigated by the Public Health Service Shellfish Sanitation Laboratory in cooperation with the States (2) (3). These studies have shown: (1) oysters as harvested in the Gulf States are of higher coliform content than are those harvested from areas of like sanitary quality in New England and Middle Atlantic States; (2) a significant increase in the coliform content may take place in the shell oyster prior to shucking; and (3) an increase in bacteria content takes place during shucking. These results are shown in table III.

Results obtained in these bacteriological studies of shellfish harvesting, shucking-packing and marketing were reviewed at the 1956 Shellfish Sanitation Workshop (2). In recognition of the data presented, the 1956 Workshop recommended the temporary use of an "Acceptable," "Acceptable-on-Condition," and "Rejectable" classification based

on a combined coliform MPN—standard plate count index of quality for shucked Eastern oysters as marketed. The 1956 Workshop also recommended that the Public Health Service and the interested States undertake a cooperative study of the bacteriological quality of shucked Eastern oysters shipped from Chesapeake Bay to New York and Canadian markets. Such a cooperative study was undertaken by the interested State and Federal agencies in the fall of 1956.

The results of this two-year study were discussed at the 1958 Shellfish Sanitation Workshop (3). On the basis of these discussions the Workshop recommended a two part "Acceptable-Rejectable" interim market standard for shucked Eastern oysters based on fecal coliform MPN's and standard plate counts.

TABLE III
Coliform MPN's and Standard Plate Counts of Oysters During Harvesting and Processing

	Percent of samples in stated group or less					
	Shell oysters			Shucked oysters		
	Dug	0 hours ¹	12 hours ²	As shucked ³	Pots ⁴	As packed ⁵
COLIFORM MPN RANGE						
Less than 230	63	45	5	5	0	0
231-2400	90	81	15	5	5	5
2401-24,000	97	100	50	47	31	79
24,001-160,000	100		85	79	47	95
160,000 or more			100	100	100	100
Number of samples	30	11	20	19	19	19
STANDARD PLATE COUNT RANGE						
1-1500	29	0	5	0	0	5
1600-10,000	79	82	15	5	5	10
11,000-50,000	90	100	30	20	10	52
51,000-1,000,000	100		100	90	100	100
1,000,000 or more				100		
Number of samples	28	11	20	20	19	19

¹ Shell oysters as delivered to the shucking plant.

² Shell oysters after 12 hours storage at shucking plant.

³ Oysters at time of shucking.

⁴ Oysters as delivered to packing room.

⁵ Shucked oysters as packed.

Source: Proceedings, 1956 Shellfish Sanitation Workshop; *Bacteriological Examination as an Indicator of Sanitary Quality of Market Shellfish*, Kelly, C. B.

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Revised 1962

Cooperative Program for the Certification of Interstate Shellfish Shippers

Part II

SANITATION
of the
HARVESTING and PROCESSING
of
SHELLFISH

1962 Revision



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Compiled and edited by
EUGENE T. JENSEN, Sanitary Engineer Director



U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service

Division of Environmental Engineering and Food Protection
Shellfish Sanitation Branch
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- 1925. Supplement No. 53 to Public Health Reports, November 6, 1925 "Re-
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in the United States".
- 1937. United States Public Health Service Minimum Requirements for
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Shippers in Interstate Commerce. (Revised October 1937)
- 1946. Manual of Recommended Practice for Sanitary Control of the Shellfish
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Introduction

In 1925 State and local health authorities and representatives of the shellfish industry requested the Public Health Service to exercise supervision over the sanitary quality of shellfish shipped in interstate commerce. In accordance with this request, a cooperative control procedure was developed. In carrying out this cooperative control the States, the shellfish industry, and the Public Health Service each accept responsibility for certain procedures as follows:

1. Procedures To Be Followed by the State.—Each shellfish-shipping State adopts adequate laws and regulations for sanitary control of the shellfish industry, makes sanitary and bacteriological surveys of growing areas, delineates and patrols restricted areas, inspects shellfish plants, and conducts such additional inspections, laboratory investigations, and control measures as may be necessary to insure that the shellfish reaching the consumer have been grown, harvested, and processed in a sanitary manner. The State annually issues numbered certificates to shellfish dealers who comply with the agreed-upon sanitary standards, and forwards copies of the interstate certificates to the Public Health Service.

2. Procedures To Be Followed by the Public Health Service.—The Public Health Service makes an annual review of each State's control program including the inspection of a representative number of shellfish-processing plants. On the basis of the information thus obtained, the Public Health Service either endorses or withholds endorsement of the respective State control programs. For the information of health authorities and others concerned, the Public Health Service publishes a semimonthly list of all valid interstate shellfish-shipper certificates issued by the State shellfish-control authorities.

3. Procedures To Be Followed by the Industry.—The shellfish industry cooperates by

obtaining shellfish from safe sources, by providing plants which meet the agreed-upon sanitary standards, by maintaining sanitary plant conditions, by placing the proper certificate number on each package of shellfish, and by keeping and making available to the control authorities records which show the origin and disposition of all shellfish.

The fundamental components of this cooperative State-Industry-PHS shellfish certification program were first described in a *Supplement to Public Health Reports*, "Report of Committee on Sanitary Control of the Shellfish Industry in the United States" (1925). This guide for sanitary control of the shellfish industry was revised and reissued in 1937 and again in 1946. It was separated into two parts by publication of Part II, Sanitation of the Harvesting and Processing of Shellfish in 1957 and by publication in 1959, of Part I, Sanitation of Shellfish Growing Areas. The need for a specialized program of this nature was reaffirmed at the National Conference on Shellfish Sanitation held in Washington, D.C., in 1954 (1) and at the Shellfish Sanitation Workshops held in 1956 (2), 1958 (3), and 1961 (67).

This edition of the shellfish sanitation manual has been prepared in cooperation with the State shellfish control authorities in all coastal States, food control authorities in the inland States, interested Federal agencies, Canadian Federal departments, the Oyster Institute of North America, the Pacific Coast Oyster Growers Association, and the Oyster Growers and Dealers Association of North America.

Since the growing and processing of shellfish are two distinct phases of operation in the shellfish industry, the manual has been prepared in two parts: I: Sanitation of Shellfish-Growing Areas; and II: Sanitation of the Harvesting and Processing of Shellfish. This, Part II of the manual is intended

as a guide for the preparation of State shellfish sanitation laws and regulations, for sanitary control of the harvesting and processing of shellfish, and for the shellfish industry in the maintenance of sanitary conditions during the harvesting and processing of shellfish. It is intended that States participating in the cooperative State-PHS-Industry program for the certification of interstate shellfish shippers will be guided by this manual in exercising sanitary supervision over harvesting, shucking, packing, repacking, and reshipping shellfish, and in the issuing of certificates to shellfish shippers.

The manual will also be used by the Public Health Service in evaluating State shellfish sanitation programs to determine if the programs qualify for endorsement.

The provisions of this manual were accepted at the Shellfish Sanitation Workshop held in Washington, D.C., November 28-30, 1961, and unless otherwise stated become effective 60 days after publication (67).

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Definitions

And/or.—Where this term is used, *and* shall apply where possible; otherwise, *or* shall apply.

Approved area.—An area which has been approved by the State control agencies for growing and/or harvesting of shellfish for direct marketing.

Classes of shippers.—(a) *Reshippers* are shippers who transship shucked stock in original containers, or shell stock, from certified shellfish shippers to other dealers or to final consumers. (Reshippers are not authorized to shuck or repack shellfish.)

(b) *Repackers* are shippers, other than the original shucker, who pack shucked shellfish into containers for delivery to the consumer. Shippers classified as repackers may shuck shellfish if they have the necessary facilities. A repacker may also act as a shell-stock shipper if he has the necessary facilities.

(c) *Shell-stock shippers* are shippers who grow, harvest, buy, and/or sell shell stock. They are not authorized to shuck shellfish nor to repack shucked shellfish.

(d) *Shucker-packers* are shippers who shuck and pack shellfish. A shucker-packer may act as a shell-stock dealer. (Shucker-

packers are classified as repackers if shucked shellfish are *regularly* repacked.)

Dry storage.—The storage of shell stock out of water.

Food-product zone.—The parts of food equipment, including auxiliary equipment (such as blower pipes and drain valves), which may be in contact with the food being processed, or which may drain into the portion of equipment with which food is in contact.

Internal temperature.—Actual temperature of shucked shellfish in the container, as opposed to the air temperature of the refrigerator in which the shellfish may be stored.

Shellfish.—All edible species of oysters, clams, or mussels, either shucked or in the shell, fresh or frozen. (For the purpose of this manual, the term does not include crabs, shrimp, or lobsters.)

Shell stock.—Shellfish which remain in their shells.

Shucked shellfish.—Shellfish, or parts thereof, which have been removed from their shells.

Wet storage.—The temporary storage of shellfish from approved sources, intended for marketing, in tanks containing sea water or in natural bodies of water, and including storage in floats.

Section A

HARVESTING AND HANDLING SHELL STOCK

1. Boats and Trucks.—All boats used in tonging, dredging, or transporting shellfish, including "buy" boats, and all trucks used for hauling bulk shell stock shall be so constructed, operated, and maintained as to prevent contamination or deterioration of the shellfish, and shall be kept clean.

Public-health reason.—Precautions exercised in gathering shellfish from approved growing areas may be nullified by contamination with bilge water or polluted overboard water.

Satisfactory compliance.—This item will be satisfied when—

a. Decks and/or storage bins are so constructed and located as to prevent bilge water or polluted overboard water from coming into contact with the shellfish. Removable false bottoms will ordinarily be required in all small craft, including rowboats, skiffs, and power boats, used in the transport of shell stock.

b. Bilge pumps are so located that pumpage will not contaminate shellfish.

c. Sacks or other containers used for the storage of shellfish are clean.

d. Boat decks and storage bins are kept clean with water from an approved source.

e. Decks and storage bins of boats used for transporting shellfish from polluted areas to approved areas for relaying are cleaned and are given bactericidal treatment before they are used for the transport of shellfish from approved areas.

f. Trucks used for the transport of bulk shell stock are so constructed as to protect the shellfish from contamination, and are kept clean.

2. Washing of Shell Stock.—Shell stock should be washed reasonably free of bottom sediments and detritus as soon after harvesting as is practicable. The primary responsibility for washing rests with the harvester.

Water used for shell-stock washing should be obtained from an approved growing area, or from other sources approved by the State regulatory agency.

Public-health reason.—When muddy shell stock are shucked, quantities of mud and bacteria are mixed with the shucked shellfish, thereby contributing to high bacteria counts in the finished product.

These bacteriological changes which take place during the shucking of oysters (*Crassostrea virginica*) in the Middle Atlantic States have been investigated at the Public Health Service's Shellfish Sanitation Laboratory (Kelly and Arcisz: "Bacteriological Control of Oysters During Processing and Marketing," *Public Health Reports*, vol. 69, no. 8, Aug. 1954).

During shucking, the percentage of samples of oysters having coliform Most Probable Numbers (MPN's) in excess of 2,400 per 100 ml. of meats was found to increase from 18 to 72, and the percentage of samples of oysters having coliform MPN's in excess of 24,000 per 100 ml. of meat increased from zero to 14. Mud and detritus adhering to the shells were implicated as responsible for the increase in coliform counts.

Muddy shell stock also make it difficult to maintain shucking rooms in a clean, sanitary condition.

Water used for shell-stock washing should be of good sanitary quality, to avoid possible contamination of the shell stock.

Satisfactory compliance.—This item will be satisfied when:

a. Shell stock are washed reasonably free of bottom sediments and detritus as soon after harvesting as is feasible. Washing of naturally clean shell stock is not necessary. Shell stock should preferably be washed at the time of harvesting; however, this may

not always be feasible because of the harvesting method or climatic conditions. In other instances, shell-stock washing by the harvester might introduce a sanitary hazard because of the possible tendency of the harvester to wash the shell stock with polluted water from a harbor area, rather than with clean water from a growing area. State shellfish-control authorities may, therefore, at their discretion, waive the requirement for shell-stock washing by the harvester when, in the State's opinion, there are climatic, technical, or sanitary reasons for such action.

b. Water used for washing shell stock is obtained from an approved growing area, or from other sources approved by the State regulatory authority.

3. Disposal of Body Excretions.—During the marketing season, body excretions shall not be discharged overboard from a boat used in the harvesting of shellfish, or from "buy" boats while in areas from which shellfish are being harvested. The State shellfish control agency, when necessary, shall specify the device and practices necessary to eliminate the overboard discharge of body excretions from boats used in harvesting of shellfish.

Public-health reason.—Gastrointestinal infections may be conveyed by shellfish; hence, it is necessary to protect the shellfish from

pollution by disease-causing organisms that may be present in body excretions. This item is intended to protect the shellfish from chance pollution during harvesting. The discharging of body excretions from either harvesting or "buy" boats will be considered in the evaluation of harvesting practices.

Satisfactory compliance.—This item will be satisfied when:

a. No body excretions are discharged from a boat used in harvesting shellfish while in an area from which shellfish are being harvested.

b. No body excretions are discharged from a "buy" boat while in an area in which shellfish are being harvested.

c. It is evident that soil cans, if provided, are used for the purpose intended.

d. Soil cans, where used, are so secured and located as to prevent contamination of the shellfish by spillage or leakage.

e. The contents of soil cans are disposed of by discharge into an approved sewage-disposal system, and soil cans are cleaned before being returned to the boat.¹ (Facilities used for cleaning food-processing equipment may not be used for this purpose.)

¹ For use and construction of soil-can-washing facilities, see Public Health Service Publication No. 66, *Handbook on Sanitation of Railroad Servicing Areas*, on sale by the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C., at 20 cents.

Section B

SHUCKING AND PACKING SHELLFISH

1. Wet Storage.—Shellfish in wet storage shall be protected against sewage contamination. Wet storage shall not be practiced by a shipper unless written approval is given each year by the State regulatory authority. This approval is to include a sketch, drawn to scale, showing the approved location of the storage area, floats or the water intake for the wet-storage tanks, and all the potential hazards to which the stored shellfish may be exposed. The approval statement shall describe the measures taken to protect the shellfish from the potential hazards. The presence of usable wet-storage tanks in a plant, or the presence of usable floats in the water, shall be deemed evidence that wet storage is being practiced.

Public-health reason.—Removal of shellfish from growing beds to storage areas close to shore and habitations, and frequently in shallow water, may subject an accumulated quantity of shellfish to constant or intermittent pollution. Shellfish in wet-storage tanks are similarly subject to pollution if the water is obtained from a polluted source. Shellfish on floats are more directly exposed to chance contamination from boats than are shellfish stored in the growing areas themselves, since it is customary to “float” the shellfish near the surface, where fresh sewage is apt to be found in greatest concentration. Shellfish on floats, therefore, are protected to a less degree by dilution than are shellfish on bottom areas.

Satisfactory compliance.—This item will be satisfied when:

a. Shellfish in wet storage are protected against sewage contamination.

b. Wet storage is practiced only in strict compliance with the terms of the written ap-

proval of the State regulatory authority. This approval is to include: (1) a sketch, drawn to scale, showing the location of the storage area or water intakes and the potential hazards to which the shellfish may be exposed; and (2) a statement describing the measures taken to protect the shellfish from the above potential hazards. This written approval shall be valid for not more than 12 months.

2. Plant Arrangement.—Plants in which shellfish are shucked and packed shall, to the extent feasible, be so located that they will not be subject to flooding by high tides. If plant floors become flooded, shucking shall be discontinued until after waters have receded and the building cleaned.

Shucking and packing operations shall be conducted in separate rooms. A shucked-stock delivery window shall be installed in the partition between the two rooms. Packing rooms shall be of sufficient size to permit sanitary handling of the product and thorough cleaning of equipment.

A separate room or rooms, or lockers, shall be provided for storing employees' street clothing, aprons, gloves, and personal articles.

Public-health reason.—The nature of the shucking operation is such that the shuckers' clothing becomes very soiled. If shuckers enter the packing room, shucked stock, cans, and other equipment may become contaminated. Rooms or lockers should be provided for clothing, aprons, and gloves to eliminate the tendency to store such articles on the shucking benches or in packing rooms, where they interfere with plant cleanup and operation.

Satisfactory compliance.—This item will be satisfied when:

a. Processing establishments are so located that they will not be subject to flooding by ordinary high tides. (A minimum plant elevation of at least 2 feet above high tides is recommended.) If plant floors are flooded, shucking is discontinued until after waters have receded and the building is cleaned.

b. Shucking and packing operations are carried on in separate rooms. Flytight screening may be accepted in lieu of a solid wall between the shucking and packing rooms, provided that the packing room is so situated that there is no likelihood of the shucked product or packing-room equipment being contaminated by splash from the opening room.

c. The delivery window is equipped with a corrosion-resistant shelf of metal, concrete, or tile, draining toward the shucking room and, if necessary, curbed on the packing-room side.

d. Packing rooms are large enough to permit sanitary handling of shellfish and thorough cleaning of equipment.

e. Rooms or lockers are provided which have adequate capacity for storing clothing, aprons, gloves, and other personal articles of employees.

3. Dry Storage of Shell Stock.—Shell stock in dry storage shall be protected from contamination. Rooms, benches, or hoppers shall be provided for the storage of shell stock. Floor wastes from a shell-stock storage area shall be discharged through a separate drainage system, or, if discharged into a general drainage system carrying sanitary wastes, an air gap shall be provided.

Public-health reason.—If shell stock are stored where polluted ground or surface water or floor drainage can accumulate, the shell stock may become contaminated. Shell stock may also be contaminated by domestic animals and rodents (see Section B, Items 12 and 15).

Satisfactory compliance.—This item will be satisfied when:

a. The storage-area floor is constructed of material impervious to water, is free from cracks and uneven surfaces that interfere with proper cleaning or drainage, and is graded to assure complete and rapid drainage of water away from the shellfish.

b. Walls of shell-stock storage rooms and hoppers are smooth and of material which will not deteriorate under repeated washing.

c. Shell-stock storage areas are so constructed that they will not receive floor drainage water from other portions of the plant. If such construction is not feasible, the shell stock should be stored on racks to prevent them from coming into contact with the floor or with water which might accumulate on the floor. Shell-stock storage areas should not serve as an entry way to other areas of the establishment. Shell-stock storage areas are protected against sewage backflow by the installation of an airgap in the waste line or by provision of a separate drain system.

d. Conveyances or devices used in the transport of shell stock are so constructed that they may be easily cleaned and are kept reasonably clean. (Use of impervious material is recommended wherever possible.)

4. Floors.—Floors shall be constructed of concrete or other material impervious to water, and shall be graded to drain quickly, shall be free from cracks and uneven surfaces that interfere with proper cleaning or drainage, and shall be maintained in good condition.

Public-health reason.—Properly graded floors, of durable, impervious material, maintained in good condition, permit rapid disposal of liquid and solid wastes, and are easily cleaned.

Satisfactory compliance.—This item will be satisfied when:

a. The floors of all rooms in which shellfish are shucked or packed, or in which utensils are washed, are constructed of concrete of good quality, or of equally impervious tile laid closely with impervious joint material, or of metal surfacing with impervious joints, or of any other material which is equivalent to good quality concrete; and when the floors are maintained in good repair.

b. The floor surface is smooth, and graded to drain, and the junctions between floors and walls are impervious to water.

5. Walls and Ceilings.—The interior surfaces of rooms in which shellfish are shucked or packed, or in which utensils are washed,

shall be smooth, washable, light-colored, and kept in good repair.

Public-health reason.—Smooth, washable walls and ceilings are more easily kept clean and are, therefore, more likely to be kept clean. A light-colored paint or finish aids in the distribution of light and in the detection of unclean surfaces. Clean walls and ceilings are conducive to clean shellfish handling.

Satisfactory compliance.—This item will be satisfied when interior surfaces are of tile, concrete, cement plaster, concrete blocks, painted wood, or equivalent material, having a smooth, washable, light-colored surface. (Structural members may be exposed, provided that they do not interfere with cleaning.)

6. Fly-Control Measures.—All outer openings to toilet and wash rooms, shucking and packing rooms, utensil cleaning and storage rooms, and locker rooms shall be effectively screened during the seasons when flies are present, unless other effective means are provided for preventing the entrance of flies. Effective in-plant fly-control measures shall be used to kill or capture flies which may enter the plant despite the screening. Shell-stock storage rooms shall be screened as necessary, to prevent the entrance of flies into the other portions of the plant. All interior doors or other openings into the packing room should be screened whenever necessary to keep the packing room free of flies.

Public-health reason.—Flies may contaminate the shellfish with disease organisms, thus nullifying the effectiveness of all other public-health safeguards.

Satisfactory compliance.—This item will be satisfied when:

a. All outer openings are effectively screened whenever flies are present; or other effective devices are provided to prevent the entrance of flies.

b. Screen doors open outward and are self-closing.

c. Flies are not present.

d. Necessary internal fly-control measures are used, and such measures are approved by the State regulatory authority.

7. Lighting.—Ample natural and/or arti-

ficial light shall be provided in all working and storage rooms.

Public-health reason.—Adequate lighting encourages cleanliness of rooms, equipment, and product, and helps to prevent eyestrain.

Satisfactory compliance.—This item will be satisfied when work and storage rooms are lighted to at least the intensity indicated below:

Type of Area	Foot-Candles of Illumination ¹
Working surfaces in packing rooms-----	² 25
Shucking benches and utensil-washing areas--	² 15
Storage rooms, including cold-storage rooms--	³ 5

¹ Approximate. Measure as incident light.

² Overall illumination level in area should be at least 10 ft.-c.

³ Measured 30 inches above the floor.

8. Heating and Ventilation.—Working rooms shall be ventilated, and shall be heated when necessary.

Public-health reason.—Uncomfortable working conditions impair the efficiency of the workers, and may result in insanitary practices.

Proper ventilation reduces condensation, and aids in retarding the growth of mold.

Satisfactory compliance.—This item will be satisfied when:

a. A comfortable working temperature is maintained.

b. Sufficient ventilation is provided to eliminate odors, discomfort, and excessive condensation.

9. Water Supply.—The water supply shall be easily accessible, adequate, and of a safe and sanitary quality.

Public-health reason.—The water supply should be accessible in order to encourage its use in cleaning operations; it should be adequate to insure proper washing, rinsing, and bactericidal treatment of the equipment; and it should be of a safe and sanitary quality, to avoid contamination of the equipment and product.

Satisfactory compliance.—This item will be satisfied when:

a. The water supply is approved as safe by the responsible State authority, or complies with the Public Health Service *Drinking Water Standards*. (Private water systems are so constructed and operated as to be at least equal to the recommendations contained

in Public Health Service Publication No. 24, "Manual of Individual Water Supply Systems.")^{2 3}

b. All shell-stock storage rooms, shucking and packing rooms, and utensil washrooms are provided with water outlets.

c. An automatically regulated hot-water system is provided which has sufficient capacity to furnish water with a temperature of at least 130° F. during all hours of plant operation.

d. Sufficient water is available for all plant needs. (Nonpressure supplies will not constitute compliance.)

e. Hot and cold water outlets are provided at each sink compartment, except that warm water only may be acceptable at handwashing sinks, as provided by Section B, Item 10e.

10. Plumbing and Related Facilities.—Plumbing shall be installed in compliance with State and local plumbing ordinances, or, in the absence of such ordinances, shall be substantially equivalent to the recommendations contained in the *American Standard National Plumbing Code ASA A40.8-1955*.⁴ Lavatories with running hot and cold (or warm) water shall be so located that their use by plant personnel can be readily observed. Signs shall be posted in toilet rooms and near lavatories, directing employees to wash their hands before starting work and after each interruption. Conveniently located, separate toilets shall be provided for each sex; however, separate toilet facilities for each sex shall not be required when family shucking is carried on and satisfactory toilet facilities are located nearby, or when the plant has fewer than 10 employees.

Public-health reason.—The organisms causing typhoid fever, para-typhoid fever,

dysentery, and other gastro-intestinal diseases may be present in the body discharges of cases or carriers, and may thus be present in the drainpipes in the plants. Correctly installed plumbing protects the water supplies from back-siphonage through improperly installed fixtures or equipment. A safe water supply in a plant contributes to product purity and to the safety of the workers.

Handwashing facilities, including running water, soap, and sanitary drying facilities, are essential to the personal cleanliness of food-service workers. The posting of a handwashing sign is necessary to remind plant employees of this important public-health practice.

Satisfactory compliance.—This item will be satisfied when:

a. Plumbing is installed in compliance with State and local plumbing ordinances, or is substantially equivalent to the recommendations contained in the *American Standard National Plumbing Code ASA A40.8-1955*.

b. There are no cross-connections between the approved pressure water supply and water from a nonapproved source, and there are no fixtures or connections through which the approved pressure supply might be contaminated by back-siphonage.

c. There is at least 1 lavatory for every 20 employees among the first 100 employees, and at least 1 lavatory for each 25 employees in excess of the first 100. (Twenty-four lineal inches of wash sink or 18 inches of a circular basin, when provided with water outlets for such space, will be considered equivalent to 1 lavatory.)

d. Handwashing facilities are convenient to the work areas, and are so located that the person responsible for supervision can readily observe that employees wash their hands before beginning work and after each interruption. (Ordinarily, there should be at least one lavatory in the packing room for use by packing-room workers.)

e. The lavatories are provided with hot water (at least 100° F.), either from a controlled-temperature source with a maximum temperature of 115° F., or from a hot-and-cold mixing or combination valve. (Steam-

² This publication is obtainable from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D.C.; price 30 cents.

³ The regulatory agency should collect water samples for bacteriological examination at not less than semiannual intervals if the supply should be from a private source. In addition, samples for bacteriological examination should be collected from all new private sources of supply before they are used, and from repaired supply facilities after they have been disinfected. Bacteriological examination shall be made in conformity with the standard methods recommended by the American Public Health Association.

⁴ This publication is obtainable from the American Society of Mechanical Engineers, 29 West 39th Street, New York 18, N.Y.

water mixing or steam-water combination valves are not acceptable.)

f. Supplies of soap and single-service hand towels are available near the lavatory. (Other sanitary drying devices, if approved by the State regulatory agency, are also acceptable.)

g. Handwashing signs are posted in toilet rooms and near lavatories.

h. The toilet-room doors are tight-fitting and self-closing.

i. The toilet rooms are kept clean and in good repair.

j. A supply of toilet paper is available in the toilet rooms.

k. At least 5-foot-candle illumination (natural or artificial) is provided in toilet rooms; and toilet rooms are ventilated by a direct opening to the outer air, or by a mechanical ventilating system. (Exhaust fans, if used, should have a minimum capacity of 2 cubic feet a minute per square foot of floor area.) Air vents should be screened or have self-closing louvers.

l. Conveniently located, separate toilets are provided for each sex, excepting that separate facilities need not be required when family shucking is carried on and satisfactory toilets are located nearby, or when the plant has fewer than 10 employees. The number of water closets provided complies with applicable State laws. In the absence of such laws, the following number of water closets should be provided:

Number of employees	Number of water closets ¹	
	Male	Female
1 to 9	1	1
10 to 24	2	2
25 to 49	3	3
50 to 74	4	4
75 to 100	2 5	2 5

¹ Wherever urinals are provided, one water closet less than the number specified may be provided for each urinal installed, except that the number of water closets in such cases should not be reduced to less than two-thirds of the minimum specified. A 24-inch trough will be considered equivalent to 1 urinal.

² One additional fixture for every 30 employees over the first 100.

m. No drainpipes or wastepipes are located over food processing or storage areas, or over areas in which containers or utensils are stored or washed.

11. Sewage Disposal.—Sewage shall be discharged into public sewers wherever possible. Where private sewage-disposal systems must be utilized, they shall be constructed according to State and local requirements; provided, that privies shall be acceptable only where water-carriage systems are not feasible. All newly constructed individual water-carriage systems shall be at least equal to the recommendations contained in the "Manual of Septic Tank Practice," Public Health Service Publication No. 256.⁵ All sewage-disposal facilities shall be so constructed and maintained that waste will be inaccessible to flies and rodents.

Public-health reason.—The organisms causing typhoid fever, para-typhoid fever, and dysentery may be present in the body discharges of cases or carriers. When sewage-disposal facilities are of a satisfactory type, there is less possibility that the shellfish being processed may become contaminated with fecal material carried by flies or rodents.

Nonwater-carriage sewage-disposal systems should be of a sanitary type, so that excreta are not accessible to flies or rodents.

Satisfactory compliance.—This item will be satisfied when:

a. Sewage is discharged into public sewers wherever possible.

b. Any private sewage-disposal facilities utilized are constructed and operated so as to comply with State and local requirements and privies are accepted only where water-carriage systems are infeasible. Any newly constructed individual water-carriage systems are at least equal to the recommendations contained in the "Manual of Septic Tank Practice," Public Health Service Publication No. 256.

c. No human excreta are accessible to flies or rodents.

12. Rodent Control.—Shellfish-processing plants shall be free from rodents.

⁵ This publication is obtainable from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D.C.; price 40 cents.

Public-health reason.—Rodents may contaminate the shellfish, utensils, or containers.

Satisfactory compliance.—This item will be satisfied when:

a. The plant is so constructed as to prevent ready entrance of rodents, and there is no evidence of rodents in any part of the plant.

b. Rodenticides which are highly toxic to humans are not stored in shellfish-processing plants, and are not used except under the supervision of a licensed pest-control operator or other qualified specialist. (Rodenticides which have a low toxicity for humans should be identified, stored, and used in such a manner as to prevent contamination of the product or ingredients, and to cause no health hazards to employees.)

13. Construction of Shucking Benches and Tables.—The tops of shucking benches and tables, and contiguous walls to a height of at least 2 feet above the bench top, shall be of smooth concrete, corrosion-resistant metal, or other durable, nonabsorbent material, free from cracks, and so constructed that drainage is complete and rapid and is directed away from the stored shellfish. Shucking blocks shall be easily cleanable. Wooden shucking blocks, if used, shall be of solid, one-piece construction, and shall be easily removable. Shucking blocks of lead or other toxic materials are prohibited. Stands or stalls, if any, shall be of painted, finished material.

Public-health reason.—Unless shucking benches, stands, blocks, and stalls are made of smooth material and are easily cleaned, they will become very dirty and may contaminate the shellfish.

Satisfactory compliance.—This item will be satisfied when:

a. Shucking benches and contiguous walls to a height of at least 2 feet above the bench tops are of smooth concrete, corrosion-resistant metal, or other durable, nonabsorbent material, free from cracks.

b. Benches drain completely and rapidly, and drainage is directed away from any shellfish on the benches.

c. Shucking blocks are easily cleanable; of nontoxic material; of solid, one-piece construction; and, unless an integral part of the bench, are easily removed from the shucking

bench. (Lead is acceptable for weighting breaking blocks only where the shellfish or knife will not come into frequent contact with the metal.)

d. Stands (or stalls) and stools are of painted, finished material.

e. Shuckers' stools have no attached padding, and are so constructed as to be easily cleaned.

14. Construction of Utensils and Equipment.—The food-product zone of utensils and equipment, including that used for ice-handling, shall be made of smooth, corrosion-resistant, impervious, nontoxic material which will not readily disintegrate or crack; and the utensils and equipment shall be so constructed as to be easily cleaned, and shall be kept in good repair.

Public-health reason.—Colanders, shucking pails, skimmers, blowers, and other equipment or utensils which come into contact with the shucked shellfish and which have cracked, rough, or inaccessible surfaces, or which are made of improper material, are apt to harbor accumulations of organic material in which bacteria or other microorganisms may grow. These microorganisms may later cause illness among those who eat the shellfish, or spoilage in the shucked shellfish.

The slime and foreign material which accumulate in blower air-pipes below the liquid level afford an excellent breeding place for bacteria. This material may be dislodged and forced into the batch of shucked shellfish then in the blower, thus increasing the bacterial content of the shellfish.

Satisfactory compliance.—This item will be satisfied when:

a. All pails, dip buckets, colanders, skimmers, paddles, tables, storage containers, returnable containers, blowers, and other equipment which come into contact with shucked shellfish, or with ice used for direct cooling of shellfish, are constructed of corrosion-resistant, nonabsorbent, nontoxic, smooth material which will not readily crack or disintegrate. (The use of enameled, tinned, or galvanized material in the food-product zone of equipment other than single-service shipping containers is not acceptable.)

b. There are no exposed screw, bolt, or rivet heads in the food-product zones, and all joints in the food-product zone are welded or soldered flush and have a smooth surface. (The use of welded joints which have been ground smooth is recommended, because soldered joints have been proven to be generally unsatisfactory for equipment used in the shellfish industry.)

c. Tanks, tubs, and shucked-stock storage containers are so located that their top rim is at least 2 feet above the floor.

d. All utensils and equipment are in good repair.

e. All equipment, including external and internal blower airlines and/or hoses below a point 2 inches above the overflow level of the tank, and blower drain valves, is so constructed as to be easily cleanable; when perforations in skimmers and collanders are smooth, to facilitate cleaning; when all internal angles in the food-product zone are filleted or otherwise fabricated to have an internal radius of at least $\frac{1}{4}$ -inch; and when there are no V-type threads in the food-product zone of the blower. (The use of wire mesh in the food-product zone of equipment is not acceptable).⁷ Nonfood-product zones of equipment should be so constructed that they can be kept in a clean, sanitary condition; seams and joints should be welded, whenever possible; outside seams should be welded or filled with solder; and there should be no inaccessible spaces in which dirt or organic material might accumulate.

f. The blower drain is not directly connected with a sewer.

g. A stand or shelf constructed of corrosion-resistant material, located so that the rim of the receiving container will be at least 2 feet above the floor, is provided under all chutes from skimmers and blowers, unless blowers discharge directly to a skimmer.

h. Air-pump intakes are located in a protected place.

i. Containers are clean; are fabricated of nontoxic metal, waxed paper, glass, or other impervious material; are so designed and fabricated that the contents will be protected

from contamination during shipping and storage; covers of returnable containers are so designed as to protect the pouring lip of the container; and returnable containers are sealed so that tampering can be detected.

15. General Cleanliness.—Premises shall be kept clean and free of litter and rubbish. Miscellaneous and unused equipment and articles which are not necessary to plant operations shall not be stored in rooms used for shell-stock storage, shucking, packing, or repacking. No domestic animal or fowl shall be permitted to be in a shellfish-processing plant. The shell-stock storage, shucking, and packing portions of the plant, when in operation, shall be restricted to the handling of shellfish. Unauthorized persons shall be excluded from the plant.

Public-health reason.—The presence of unused equipment and material interferes with the proper cleaning of the plant and equipment, and may, therefore, contribute indirectly to contamination of the food product. Shell or shucked stock may be contaminated by domestic animals, fowls, or rodents.

Satisfactory compliance.—This item will be satisfied when:

a. Material and equipment not in routine use are not stored in rooms used for shell-stock storage, shucking, packing, repacking, or container storage.

b. The shell-stock storage, shucking, and packing portions of the plant are not used for other operations while shellfish are being processed.

c. No domestic animals, rodents, or fowl are permitted in shellfish-processing plants.

d. Only personnel engaged in packing operations, supervisory personnel, authorized inspectors, or other persons specifically authorized by the plant manager, are allowed in the shell-stock storage, shucking, or packing rooms during periods of operation.

e. Premises are clean and free of litter and rubbish.

f. Shuckers do not go into or through the packing room for any purpose. (An exception may be made in small operations, where an employee may work in both the packing room and the shucking room. In such cases, the employee should be required to change aprons and wash his hands thoroughly before entering the packing room.)

⁷ Sanitary Standards describing the construction of valves, fittings, and pumps may be obtained from International Association of Milk and Food Sanitarians, Inc., Box 347, Shelbyville, Ind. Public Health Service Publication No. 943, *Shellfish Industry Equipment Construction Guides*, obtainable from PHS Regional Offices, contains guides for sanitary construction of shellfish blower tanks, skimmers, returnable shipping containers, and shucking buckets and pans.

16. Cleaning of Buildings and Equipment.—Shucking benches, shucking stools, floors, and, if necessary, walls of the shell-stock storage rooms and packing and shucking rooms shall be cleaned within 2 hours after the day's operations have ceased. Windows and skylights shall be kept clean. Refrigerators shall be kept clean. All equipment, utensils, and work surfaces, including the external and internal blower airlines and blower drain valves, shall be cleaned by scrubbing with water and detergent and rinsing with potable water within 2 hours after the day's operations have ceased.

Public-health reason.—Clean workrooms and refrigerators reduce the chance of contaminating shellfish during shucking and processing. Shucked shellfish cannot be kept clean and safe if permitted to come into contact with equipment which has not been sanitized. Bactericidal treatment is not effective unless the equipment is first thoroughly cleaned.

The determination of adequate cleanup facilities will depend upon the method of bactericidal treatment selected (see Item 17) and plant-by-plant determination of what equipment and utensils may best be washed in a sink and what equipment may best be washed "in place." Detergents and brushes, including special brushes that may be needed for cleaning equipment such as blower lines, should be available.

SINK WASHING

Wash sinks should be made of impervious, nontoxic material. Sink compartments should be large enough to permit the complete immersion of the largest utensil to be sink-washed. A second compartment should be provided in the sink for clean-water rinsing between washing and bactericidal treatment, unless some other acceptable method, such as a spray rinse, is provided. In the case of bactericidal treatment by immersion in hot water (Item 17a (2)), both the bactericidal treatment and rinse may be accomplished simultaneously in the second compartment. If bactericidal treatment by means of immersion in chemical solutions (Item 17a (3)),

is selected, a separate compartment should be provided for this operation.

Number of Compartments Required in Sink

Method of bactericidal treatment	Method of rinse	
	Immersion	Spray
Steam cabinet.....	2	1
Hot water (170° F.).....	2	(¹)
Bactericidal solution.....	3	2

¹ Not applicable.

IN-PLACE WASHING

Utensils and equipment which have to be washed "in place" will require the same three steps of wash, rinse, and bactericidal treatment. A watertight container, such as a blower tank, is best washed by preparing a solution of the detergent in the container itself and using this to scrub all parts of the unit. Rinsing, preferably, should be accomplished either by complete filling or by thorough spray rinse. The bactericidal treatment methods are described in Item 17.

Satisfactory compliance.—This item will be satisfied when:

a. Shell-stock storage, shucking, and packing rooms are cleaned within 2 hours after the day's operations have ceased.

b. All utensils, equipment, and work surfaces, including the external and internal blower airlines below the tank's liquid level, are cleaned by scrubbing with water and detergent and rinsing with potable water within 2 hours after the day's operations have ceased.

c. Cleaned benches, blocks, and stalls are flushed or sprayed as often as necessary, and at least once each week, with a solution containing not less than 100 parts per million of available chlorine, or other disinfecting agents in effective concentrations as approved by the State regulatory authority.

d. Refrigerators are clean.

e. Adequate cleanup facilities, including sinks, detergents, and brushes, are available within the plant. Where chemical bactericides are used, a third compartment or spray rinse must be installed to permit a clean-

water rinse between washing and bactericidal treatment. (Sink compartments should be large enough to permit complete immersion of the largest utensil to be washed.)

f. All shelves, tables, and other equipment in the shucking and packing rooms are clean.

g. Wash tanks, blowers, and containers for shucked-stock holding are flushed or spray-rinsed with tapwater after each emptying. (Dismantling is not necessary.) Periodic clean-water flushing of shucking benches, utensils, table surfaces, and other equipment during working periods is recommended.

17. Bactericidal Treatment of Utensils and Equipment.—All utensils and equipment in the shucking and packing rooms which come into contact with shucked shellfish shall be subjected to an effective bactericidal process at the end of each day's operation.⁸

Large equipment which might be recontaminated before use shall be cleaned at the end of each day's operation, and shall be subjected to effective bactericidal treatment immediately before use.

Returnable shipping containers, if used, are subjected to an effective bactericidal treatment process on the day they are to be used, and are protected against contamination until filled.

Public-health reason.—Shellfish furnish an excellent growth medium for bacteria or other microorganisms. Small numbers of bacteria which might remain on improperly sanitized equipment may multiply to tremendous numbers in the finished pack.

Satisfactory compliance.—This item will be satisfied when:

a. All utensils and other equipment have been treated by one or more of the following methods:⁹

- (1) Exposure for at least 15 minutes at a temperature of at least 170° F., or for at least 5 minutes at a temperature of at

least 200° F., in a steam cabinet equipped with an indicating thermometer¹⁰ located in the coldest zone. (Absence of a thermometer violates this item.)

If steam is used in the bactericidal treatment of blowers, a suitable cover and indicating thermometer are provided. A vent or valve should be installed at the bottom of large steam cabinets, to permit the discharge of cold air when steam is admitted.¹¹

- (2) Immersion in hot water of at least 170° F. for at least 1/2 minute. (An accurate indicating thermometer is provided and used.)^{10 11} Ordinarily, a booster heater is necessary for water to be maintained at 170° F.

In the bactericidal treatment of blowers by this method, the blower may first be filled with water and then brought up to 170° F. by the addition of steam. This temperature should be checked by the indicating thermometer, and the 1/2-minute contact period measured after reaching this value. In practice, it has been found desirable to provide a connection to, or a removable section in, the blower line above the liquid level of the tank, where steam or hot water can be introduced.

- (3) Immersion for at least 1 minute in, or exposure for at least 1 minute to, a flow of a solution containing not less than 50 parts per million of free chlorine. All product-contact surfaces must be wetted by the bactericidal solution, and piping so treated must be filled. Bactericidal sprays containing not less than 100 parts per million of free chlorine may be used for large equipment. Bactericidal treatment with chemicals is not effective unless the surface has been thoroughly cleaned.

Bactericides other than chlorine should not be accepted by the inspector until official tests

⁸ Containers which have been subjected to bactericidal treatment should have a residual bacterial plate count of not more than 1 per milliliter of capacity, and equipment not over 100 colonies per 8 square inches (i. e., 2 per square cm.) of food-contact surface, in 3 out of 4 samples. (See *Standard Methods for the Examination of Dairy Products* for information on apparatus and procedure for making rinse and swab counts.)

⁹ In medium and large shucking plants, a steam cabinet with auxiliary steam boiler is a most satisfactory type of equipment for bactericidal treatment of utensils and equipment.

¹⁰ Thermometers should be accurate to within 2° F., should have scale divisions not greater than 2° F., and should be so installed as to be easily read. Accuracy of thermometer should be checked at least once each year by the State regulatory agency.

¹¹ Steam or hot-water treatment shall not be accepted as satisfactory compliance unless the equipment or containers are completely immersed or completely exposed for the required time or longer, at the required temperature or higher, throughout the period of exposure.

Amounts of Chlorine Compounds Required to Give Approximately 100 p. p. m. of Chlorine by Readily Available Measuring Devices

Volume of water (gallons)	Dry chlorine compounds—available chlorine			Liquid hypochlorite solutions—available chlorine	
	15 percent	25 percent	70 percent	1 percent	5 percent
20-----	5½ tbs-----	3½ tbs-----	1½ tbs-----	3 cups-----	10 tbs.
40-----	11 tbs-----	6½ tbs-----	2½ tbs-----	3 pts-----	1¼ cups.
60-----	1 cup-----	10 tbs-----	3½ tbs-----	4¾ pts-----	2 cups.
80-----	1¾ cups-----	13½ tbs-----	4½ tbs-----	6½ pts-----	2½ cups.
100-----	1¾ cups-----	1 cup-----	6 tbs-----	4 qts-----	3 cups.
150-----	2¾ cups-----	1½ cups-----	9 tbs-----	6 qts-----	4¾ cups.
200-----	3¾ cups-----	2 cups-----	12 tbs-----	2 gals-----	3 pts.

NOTE

Dry measure

1 tablespoon (tbs.)—approximately 0.3 ounce.
1 cup or ½-pint—approximately 5 ounces.

Liquid measure

1 tablespoon or 3 teaspoons—approximately 15 milliliters.
1 cup or ½-pint—approximately 16 tablespoons.

by the proper regulatory authority have demonstrated that the bactericide in question is satisfactory for use in connection with shellfish sanitation. The local inspector should consult his State health organization regarding other bactericides in use in his area, so that he may be certain he is using the proper tests for effectiveness and concentration.

b. Large items which cannot be stored in a protected place are given effective bactericidal treatment immediately before starting each day's operation.

18. Storage of Equipment.—Equipment and utensils which have been cleaned and given bactericidal treatment shall be stored so as to be protected against contamination.

Public-health reason.—The results of cleaning and bactericidal treatment may be negated by improper storage of the treated equipment.

Satisfactory compliance.—This item will be satisfied when the treated equipment is stored where it will be protected from contamination or unauthorized handling. (The utensils may be stored in the steam chest, in a special cabinet, or in the packing room on clean shelves, stands, tables, or racks. Storage racks should be at least 2 feet above the floor.)

19. Source of Shellfish.—All shellfish shall be obtained from a source approved by an official regulatory agency.

Public-health reason.—The positive relationship between sewage-polluted shellfish and enteric disease has been demonstrated many times. (See Report of the Committee of the Public Health Engineering Section of the American Public Health Association, *Am. J. Pub. Health*, 27: 180–196 (Supplement, March 1937); and Old, H. N., and Gill, S. L.: "A Typhoid Fever Epidemic Caused by Carrier Bootlegging Oysters," *Am. J. Pub. Health*, 30: 633–640 (1940).)

The bacterial content of shellfish will, in general, mirror the bacterial quality of the water in which they have grown. Because shellfish pump and filter a large quantity of water, the bacteria count of the shellfish will normally exceed the bacteria count of the water in which they grow. The shellfish-water bacteria ratio depends upon the shellfish species, water temperature, presence of certain chemicals, and varying capabilities of the individual animals. If the water in which the shellfish are grown contains sewage, it may be assumed that the shellfish will also contain sewage bacteria, some of which may be capable of causing disease in man.

Furthermore, there is evidence that organisms of the Salmonella group, at least, will survive in shellfish for a considerable length of time after harvesting. Kelly and Arcisz ("Survival of Enteric Organisms in Shellfish," Reprint No. 3249, vol. 69, no. 12, Dec. 1954, pp. 1205–1210, *Public Health Reports*)

have shown that viable *S. schottmuelleri* will persist for at least 49 days in shell oysters, *Crassostrea virginica*, stored at a temperature of 40° F. However, there was little evidence of multiplication of the bacteria in the shellfish during the storage period. In the same study, it was reported that *S. schottmuelleri* persisted in soft clams, *Mya arenaria*, stored at a temperature of 40° F., throughout a normal storage period.

Other public-health hazards may result from the presence of a naturally occurring paralytic shellfish poison in certain species of shellfish. The occurrence of this poison is apparently related to the concentration of a dinoflagellate, *Gonyaulax*, in the water of the growing area. Species of shellfish which may accumulate this poison under appropriate conditions include *Mytilus californianus*, *Mytilus edulis*, *Mya arenaria*, *Saxidomus giganteus*, *Donax serra*, and *Modiola modiolus*. The poison occurs only in well-defined areas and, in some instances, only during certain seasons. It is not widespread over all shellfish-producing areas. (See McFarren, et al., "Public Health Significance of Paralytic Shellfish Poison," 1956 *Proceedings*, National Shellfisheries Assn.)

Cooking does not insure safety of shellfish since, in ordinary cooking processes, shellfish may not be sufficiently heated to insure a kill of pathogenic organisms, although a considerable reduction will take place. One investigator has found that oysters must be held in a water bath at 138°–142° F. for 1 hour before the coliform count is reduced to zero. (See Salafranca, E. S., "The Effect of Salt, Vinegar, and Heat on the Coliforms in Oysters," *The Philippine Journal of Fisheries*, vol. 2, no. 1, 1953.) Also, normal cooking processes cannot be relied upon to destroy paralytic shellfish poison if it should be present.

The primary safeguard in the entire shellfish-sanitation program is, therefore, that of obtaining shellfish which are free of disease-causing organisms, and which contain, at most, only relatively small quantities of poison. If shell stock from sewage-polluted or highly toxic areas are shucked, then almost all of the other sanitary safeguards of the

cooperative certification program will have been circumvented.

Satisfactory compliance.—This item will be satisfied when all shellfish are obtained from one or more of the following sources: (a) An approved growing area; (b) a State-certified shellfish shipper; or (c) a State-approved shellfish-treatment plant.

20. Refrigeration of Shell Stock.—Shell stock of shellfish species which have poor keeping qualities (such as the soft-shell clam, *Mya arenaria*, and the mussels, *Mytilus edulis* and *Mytilus californianus*) shall be refrigerated during shipment and holding.

Public-health reason.—If shell stock of shellfish species which have poor keeping qualities are not refrigerated during prolonged storage, the quality of the product will be impaired and the bacteria counts will be increased.

Significant increases in coliform counts in shell oysters stored overnight may also occur under some conditions. Preliminary investigations of such increases in southern oysters have been undertaken by the Public Health Service Shellfish Sanitation Laboratory. The public-health significance of the increase in bacteriological counts has not yet been evaluated. It is not known whether or not a comparable increase in *Salmonella* or other pathogenic organisms would take place.

Satisfactory compliance.—This item will be satisfied when:

a. Shell stock of shellfish species with poor keeping qualities are stored at a temperature of 50° F. or less, but are not frozen, and when, at points of transfer, such as loading docks, shell stock are not permitted to remain unrefrigerated for prolonged periods.

b. Shell stock are protected from the sun during warm weather to the extent necessary to prevent spoilage.

21. Shucking of Shellfish.—Shellfish shall be shucked in such a manner that they are not subjected to contamination. Shell stock shall be reasonably free of mud when shucked.¹² Only live shellfish shall be shucked.

¹² The primary responsibility for washing the shellfish free of mud is placed on the harvesters. However, this does not relieve the plant operator of responsibility for compliance with this item. (See Section A, Item 2.)

Water used in fluming or washing shell stock shall be from a source approved by the State regulatory agency. Use of overboard water must be specifically approved by the State agency, and its use limited to shell-stock washing.

Shucked shellfish shall not remain on the shucking bench for more than 2 hours unless the shucked shellfish have an internal temperature of 50° F. or less.

Public-health reason.—If shellfish are not reasonably clean at the time of shucking, a considerable quantity of the adhering material will be mixed into the shucked shellfish during the shucking process, thus contributing to high bacteria counts in the final product. (See Public-health reason, Section A, Item 2, Washing of Shell Stock.)

The bacteria count of the final pack is related to the time intervening between shucking and attainment of a temperature of approximately 50° F., i. e., the length of time the shellfish are at a temperature favorable to the rapid growth of bacteria. Factors in the shucking-room procedure which influence the length of time shucked shellfish are above 50° F. include the quality and species of the shellfish being shucked, the speed of the individual shucker, the practice of returning "overage" or "bluff" to the shuckers, the frequency with which the shucking containers are delivered to the packing room, the air temperature, and the temperature of the shell stock being shucked.

The total elapsed time which shellfish may be held on the shucking bench without causing high bacteria counts is closely related to the packing-room procedures, the size of containers into which the shucked shellfish are being packed, the temperature of blower water, the temperature of the oysters, and the method of cooling.

From the standpoint of bacteriological quality, it is preferable that the elapsed time between shucking and the attainment of a temperature of 50° F. not exceed 4 hours. More rapid cooling is very desirable.

For this reason, the total time which the shucked shellfish may be held on the shucking bench has been limited to 2 hours when the temperature of the shellfish is above 50°

F. The return of overage (bluff) from the packing room to the shucker would ordinarily result in at least a portion of the shellfish being held on the shucking bench for more than 2 hours, and the practice is, therefore, discouraged and should be held to a minimum level by plant operators. When bench-grading of shellfish is practiced, it is especially important that all grades of shellfish be delivered to the packing room at least once every 2 hours when the temperature of the shellfish exceeds 50° F. To encourage frequent delivery of the shucked shellfish to the packing room, it is suggested that the shucking containers be limited to a size that an average shucker might reasonably be expected to shuck full in 1 hour.

Storage of shucked shellfish on the shucking benches for long periods of time increases the possibility of contamination of the shucked shellfish by splash or flies.

Bacteriological examination of the water in dip buckets has shown very high coliform counts. Since water from the dip bucket may be carried over into the shucked shellfish, there is a need for controlling the sanitary quality of the water.

Satisfactory compliance.—This item will be satisfied when:

a. Water used for fluming or washing shell stock is obtained from a source approved by the official State regulatory agency.

b. Shell stock are reasonably free of mud when shucked.

c. Only live shellfish are shucked.

d. The use of "dip" buckets is prohibited. (Where conditions dictate the need for frequent rinsing of the shucker's hands and knife, it is recommended that water outlets be installed at the shucking bench convenient to each shucker, or that a flow-through type of dip bucket, in which the water is continually replaced by clean tapwater, be installed.)

e. Shucking containers are rinsed with running tapwater before each filling.¹³

f. Shucked shellfish are not held on the shucking bench for more than approximately

¹³ Food and Drug Administration requirements limit the amount of water in the shucking containers to one-fourth of the capacity of the container.

2 hours unless the shellfish have an internal temperature of 50° F. or less.

22. Shell Disposal.—Shells from which meats have been removed shall be removed promptly from the shucking room.

Public-health reason.—Shell accumulations in the shucking room make it difficult to keep the room clean, and the chances of contaminating the shucked product are increased.

Satisfactory compliance.—This item will be satisfied when shells are promptly removed from the shucking room to prevent interference with the sanitary operation of the plant. Any method of shell removal which results in the prompt removal of shell without contaminating the shucked product is acceptable. These methods include, but are not limited to, conveyors, baskets, barrels, wheelbarrows, or shell drop-holes. (It is recommended that unused portions of body meats, such as clam siphons, not be disposed of with shells. Fly-control measures may be necessary in the vicinity of shell piles.)

23. Handling of Single-Service Containers.—All single-service containers shall be stored and handled in a sanitary manner and, where necessary, shall be given bactericidal treatment immediately prior to filling.

Public-health reason.—Single-service containers which have not been stored and handled in a sanitary manner may become contaminated and thus may contaminate the packaged shellfish.

Satisfactory compliance.—This item will be satisfied when:

a. Single-service containers and covers are kept in original cartons until used, and are kept clean and dry.

b. Containers which may have been contaminated during storage are cleaned and given bactericidal treatment immediately prior to filling, or are discarded.

c. Plant employees use every reasonable precaution to prevent the food-contact surfaces of containers from coming into contact with their person or clothing.

d. Container-storage rooms are kept clean and free of rodent or insect infestation; containers are so stored that the presence of

rodents may be easily detected;¹⁴ and container-storage rooms are not used as general storerooms for unused equipment and materials.

e. Single-service containers in the packing room are kept on stands or tables at least 2 feet above the floor, and are protected against contamination from splash.

24. Packing of Shucked Shellfish.—Shucked shellfish shall be packed without exposing them to contamination. Shucked shellfish shall be packed and shipped in clean, single-service containers made of impervious materials, or in clean, properly designed, returnable containers¹⁵ so sealed that tampering can be detected. Each individual package of fresh or frozen shellfish shall have permanently recorded on the package or label, so as to be easily visible, the packer's, repacker's, or distributor's name and address, and the packer's or repacker's certificate number preceded by the abbreviated name of the State. Containers holding 1 gallon or more shall have the identification on the container wall, unless the cover becomes an integral part of the container during the sealing process. Packages of frozen shellfish shall show the date or code of packing.

Public-health reason.—Unless shucked shellfish are packed in clean containers, all precautions taken to produce a clean and safe product may be negated.

The State permit number facilitates tracing the product to the plant in which it was actually prepared. The date or code on the frozen product further assists the regulatory authority in tracing shellfish to their point of origin.

Satisfactory compliance.—This item will be satisfied when:

a. Skimmer tables are so located that they will not receive drainage from the delivery window.

b. Shuckers do not place shucking containers on skimmers.

¹⁴ Containers should be stored on open racks or pallets at least 8 inches above the floor and 18 inches away from the walls.

¹⁵ Returnable containers will be accepted only for interplant shipment of shucked shellfish.

c. Shellfish are not exposed to contamination during packaging.

d. Containers are closed as soon after filling as is feasible.

e. The name and address of the packer, repacker, or distributor, and the certificate number, preceded by the abbreviated name of the State, of the packer or repacker, are permanently recorded on the package so as to be easily visible. Wording, such as "Packed for" or "Distributed by," is used wherever necessary to clarify the name on the label. Containers holding 1 gallon or more have the identification on the side wall, rather than on the cover, unless the cover becomes an integral part of the container during the sealing process.¹⁶ (The presence of containers or covers with a plant number other than that on the unexpired certificate for the plant will be considered a violation of this item. Packing into containers with other plant certification numbers is not permitted. Recording identification information on containers by use of a rubber stamp will not be acceptable for compliance with this item.) Returnable shipping containers may be identified with tags of at least $2\frac{5}{8}$ x $5\frac{1}{4}$ inches in size and made of substantial water-proof stock.

f. The date or code of packing is placed on each package of frozen shellfish, but this information need not be on the outer wrap. (The packaging code should be made available at the request of the State shellfish-regulatory authority. Code-dating of nonfrozen products is also recommended.)

25. Refrigeration of Shucked Shellfish.—Shucked shellfish shall be cooled to an internal temperature of 50° F. or less within 2 hours after packing. Further cooling to a temperature not exceeding 40° F. is recommended.

Shellfish which will not be packed within 1 hour after delivery to the packing room shall be cooled to an internal temperature of 50° F. or less within 2 hours.

A temperature of 0° F. or less shall be maintained in the frozen-storage rooms.

Public-health reason.—Shucked shellfish are an excellent medium for the growth of bacteria. Thus, it is very important that the

packaged shellfish be cooled promptly, so that bacteria will not multiply. Also, temperatures above 50° F. may accelerate physical deterioration and spoilage of shucked stock. Alternate freezing and thawing of shellfish may cause deterioration and spoilage.

Investigations by the New York Department of Conservation indicate that keeping qualities of shucked oysters are enhanced when a storage temperature of 2° to 4° C. (35 to 39.2° F.) is used. (See Udell, H. F., "Handling of Southern Oysters for Sale in New York Markets," *Proceedings, 1956 Meeting, National Shellfisheries Association.*)

Satisfactory compliance.—This item will be satisfied when:

a. Shucked shellfish are cooled to an internal temperature of 50° F. or less within 2 hours after packing, and are stored and shipped under similar temperature conditions. (One-gallon containers will ordinarily have to be stored in crushed or flaked ice immediately after packing, to attain this degree of cooling. For containers holding more than 1 gallon, shellfish will ordinarily require cooling prior to placement in containers.)

b. Shucked shellfish which are not to be processed within 1 hour after delivery to the packing room are so refrigerated that their internal temperature will be reduced to 50° F. within 2 hours; and holding containers are covered.

c. Shellfish which have been cooled in holding containers (par. b above) are processed and packed in such a manner that their internal temperature does not exceed 50° F.

d. Packaged shellfish to be frozen are properly stacked to insure rapid freezing, and are frozen at an ambient air temperature of 0° F. or less, with packages frozen solid within 12 hours after the start of freezing; and frozen shellfish are handled in such a manner as to remain frozen solid, and are held at 0° F. or less.¹⁷

26. Ice.—Ice shall be obtained from a source specifically approved by the State reg-

¹⁷ It is recommended that freezing and frozen-storage compartments be equipped with at least the following equipment: (1) Automatic temperature-regulating control; (2) an indicating thermometer, so installed as to indicate accurately the temperature within the storage compartment; and, (3) except for plate freezers, a recording thermometer installed on each freezing or storage compartment in such a manner as to record accurately the temperature within the compartment at all times. Recording-thermometer charts should be retained for at least 1 year.

¹⁶ Additional information on product quality, quantity, and identification may be required by Federal and/or State laws.

ulatory agency, and shall be stored and handled in a clean manner.

Public-health reason.—Ice may become contaminated during freezing or in subsequent storing and handling.

Shucked shellfish packed in non-hermetically sealed containers may also be contaminated by dirty ice. When containers of shellfish are stored in ice, a partial vacuum is formed within the container which may draw water from the melting ice into the container.

Satisfactory compliance.—This item will be satisfied when:

a. Ice is manufactured in an establishment or machine approved by the proper State regulatory authority.

b. Ice is stored and handled in such a manner that it will not be contaminated.

c. Ice, other than that manufactured in the shellfish-processing establishment, is washed before use.

27. Records.—Complete and accurate records shall be kept by every shellfish dealer.

Public-health reason.—In case of an outbreak of disease attributable to shellfish, it is necessary that health departments be able to determine the source of contamination, and thereby to prevent any further outbreaks from this source. This can be done most effectively by following the course of a shipment, through all the various dealers who have handled it, back to the point of origin by means of records kept by the shellfish dealers.

Satisfactory compliance.—This item will be satisfied when a record is kept of the dealers from whom shellfish were purchased; the dates of purchases; areas from which shellfish were harvested; and the names and addresses of persons to whom shellfish were sold. (In most cases, the record of the financial transactions of the plant constitutes a sufficient record for the purposes of this item.)

28. Health of Personnel.—Any person known to be infected with any disease in a communicable form, or to be a carrier of any disease which can be transmitted through the handling of shellfish, or who has an infected wound or open lesion on any exposed portion of his body, shall be excluded from the

shucking or packing plant. An owner or manager who has reason to suspect that any employee has contracted a communicable disease shall immediately notify the proper health officials. Pending appropriate action by the health officials, said employee shall be excluded from the plant.

Public-health reason.—Persons who are infected with, or who are carriers of, organisms of typhoid fever, dysentery, septic sore throat, or certain other communicable diseases, might transmit such disease to others through shucked shellfish. A person with an infected wound or open lesion on the exposed portion of his body might transmit toxin-producing bacteria to the shucked shellfish, and thus cause food poisoning to consumers thereof.

Careful, daily observations of the health of employees, with proper inquiries when indicated, and exclusion of employees who are ill, will tend to prevent possible contamination of the shucked stock with pathogenic organisms.

Satisfactory compliance.—This item will be satisfied when:

a. Persons with infected wounds or open lesions on the exposed portion of their bodies, and those who are known to be carriers of, or infected with, typhoid fever, dysentery, or other communicable diseases likely to be transmitted by shucked shellfish, are excluded from the plant.

b. Daily observations of employees are made by the supervisor, with reasonable inquiries being made when signs of illness appear.

c. Upon an inquiry indicating the possibility of a communicable disease, the ill employee is excluded from the plant pending clearance by the health officials.

d. Employees having diarrhea or sore throat promptly report this to the manager.

29. Supervision.—The management shall designate a reliable individual to be accountable for compliance with the items of this manual having to do with plant and personnel cleanliness.

Public-health reasons.—Handwashing by food-service employees is a very important public-health measure. Unless someone is

made specifically responsible for this practice, it is apt to be forgotten or overlooked. Similarly, one person must be responsible for plant cleanup. Clean floors, walls, and benches reduce the chance of contamination of the shellfish or utensils during shucking or packing operations. Periodic disinfection of the plant will reduce the possibility of contaminating the shellfish.

Satisfactory compliance.—This item will be satisfied when a reliable individual has been designated by the management to supervise the activities enumerated in Section B, Items 16, 28, and 30, and when there is evidence that he has been executing these duties. Designation of such an individual does not relieve management of responsibility for compliance with these items.

30. Cleanliness of Employees.—Employees shall wash their hands with soap and water before beginning work, and again after each interruption. (Supervision of handwashing is a specific responsibility of management, Section B, Item 29.)

When manual handling of shucked shellfish becomes necessary, sanitized rubber gloves shall be worn, or the hands shall be washed and disinfected immediately before such manual handling.

Finger cots, gloves, and/or shields, if worn by shuckers, shall be sanitized as often as necessary and at least twice daily. (Use of waterproof finger cots or shields is recommended as preferable to those made of an absorbent material.) Any person who handles shucked shellfish shall wear a clean apron or coat.

Employees shall not use tobacco in any form in the rooms in which shellfish are shucked or packed.

Public-health reason.—The hands of all employees frequently come into contact with their clothes; hence, it is important that the clothes worn during the handling of shucked shellfish be clean. The nature of the work makes it necessary that protective outer garments be worn. Finger cots, gloves, and/or shields, unless sanitized periodically, will accumulate bacteria which will contaminate the shucked shellfish.

Disease or toxin-producing bacteria may be carried on the hands of shuckers and/or packers; hence, handwashing is very important.

Satisfactory compliance.—This item will be satisfied when:

a. Clean aprons or coats are worn by any persons handling shucked shellfish.

b. Aprons or coats not in use are stored in a room or locker provided for this purpose.

c. Finger cots, gloves, and/or shields, if worn by shuckers, are sanitized as often as necessary and at least twice daily, and are properly stored until used. (See Section B, Item 18.)

d. Sanitized rubber gloves are worn during, or the hands are washed and disinfected *immediately* before, any manual handling of the shucked shellfish. (A bucket or pan of the bactericidal solution should be present in the packing room during periods of operation.)

e. There is no evidence of spitting, or of the use of any form of tobacco, by employees in rooms in which shellfish are shucked or packed.

f. Employees wash their hands with soap and water before beginning work and after each interruption, and utensil sinks are not used for handwashing.

Section C

PACKING AND SHIPPING SHELL STOCK

A shell-stock shipper deals only in shellfish which are still in the shell; hence, his plant sanitation requirements are not as extensive as those of a shucker-packer or repacker. A shipper holding only a shell-stock certificate shall not shuck shellfish or repack shucked shellfish. Operators of "buy" boats and "buy" trucks shall be considered shell-stock shippers.

Shellfish in the possession of a shell-stock

shipper shall be protected against contamination. The shell-stock shipper shall keep records of his purchases and sales, and shall tag shell-stock shipments so that they may be identified.

To effectuate the needed sanitary safeguards, the shell-stock shipper shall comply with items 1 and 2 below, and with the items of sections A and B indicated for each type of shell stock operation in Table II.

TABLE II

Type of shell stock operation	Shore establishment required	Item No. in section B											Comments
		1	3	9	10	11	12	*15	19	20	27	28	
Harvesting only	—	—	—	—	—	—	—	X	X	X	X	X	No storage. Packing on boat. Storage ashore.
Harvests and packs	—	—	—	—	—	—	—	X	X	X	X	X	
Harvests, stores, and packs	X	X	X	X	X	X	X	X	X	X	X	X	
"Buy" boat	—	—	—	Sec. A	—	Sec. A	—	X	X	X	X	X	Storage only on boat.
"Buy" boat and storage	—	—	X	Sec. A	—	Sec. A	—	X	X	X	X	X	
"Buy" truck	—	—	—	Sec. A	—	—	—	X	X	X	X	X	
"Buy" truck and storage	—	—	X	Sec. A	—	—	—	X	X	X	X	X	Storage on truck.
Establishment buys, packs, and stores	X	X	X	X	X	X	X	X	X	X	X	X	
Establishment buys and stores ashore	X	X	X	X	X	X	X	X	X	X	X	X	

*Part II, Section B, Items 15(b) and 15(f) are not applicable to shell-stock shippers.

X = Required.

— = Not required.

1. Washing of Shell Stock.—Shell stock shall be reasonably free of mud at the time of shipment.

Public-health reason.—See Section A, Item 2, concerning reasons for washing shell stock. If shellfish are washed in polluted water, the shellfish may be contaminated. Therefore, water used for shell-stock washing should be of approved sanitary quality. Preferably, shell stock should be washed at the time of harvesting or as soon thereafter as is feasible.

Satisfactory compliance.—This item will be satisfied when :

a. Shell stock are reasonably free of mud at the time of shipment. The qualifications applicable to washing of shell stock under Section A, Item 2a, also apply to this item.

b. Water used for shell-stock washing is from a source approved by the official State regulatory authority.

2. Packing and Shipping of Shell Stock.—Shell stock shall be packed and shipped in clean containers, under conditions which will prevent contamination. When consigned in bulk, shell stock shall be shipped in clean conveyances, under conditions which will prevent contamination.

Shell stock in transit shall be identified by a tag or label fastened to each shipping container and bearing the number of the shipper, his name and address, the name and address of the consignee, and the kind and quantity of shell stock in the container. The following classes of shell stock shippers shall be exempt from this requirement: Harvesting Only; Buy Boats; and Buy Boats with Storage on the Boats.

Public-health reason.—Shellfish must be protected during shipment to avoid contamination and spoilage. Shipments must be tagged, to make it possible for the control authorities to identify shipments of shellfish.

Satisfactory compliance.—This item will be satisfied when:

a. Shipping containers and vehicles are clean.

b. Tags at least $2\frac{5}{8}$ by $5\frac{1}{4}$ inches in size, and made of substantial, waterproof stock, and carrying the name, address, and number of the dealer, the name and address of the consignee, and the kind and quantity of the shell stock, are securely fastened to each individual container of shell stock. (Bulk shipments, "e.g., unpackaged," of shell stock to a certified shipper require only a single tag or bill of lading which gives the required information.)

Section D

REPACKING OF SHELLFISH

The packaging of shucked shellfish in plants other than those in which they were initially shucked exposes the shucked shellfish to additional handling and increases the possibility of contamination. Combining in one pack shucked shellfish from more than one dealer permits the possibility of contamination of the entire pack if shellfish from any

one of the dealers should be contaminated. When repacking is practiced, tracing of shellfish to the source is difficult.

Where repacking is practiced, it shall be done in accordance with the requirements of table III and the items which follow in this section.

1. Shucked Shellfish Intended for Repacking.—Shucked shellfish to be repacked shall be received at the repacking plant in approved shipping containers at a temperature of 50° F. or less. Frozen shellfish which have thawed shall not be repacked or repackaged.

Public-health reason.—Shellfish which are not shipped in properly sealed, easily cleanable containers may become contaminated. Shellfish which have not been properly refrigerated may have excessively high bacteria counts.

If frozen shellfish are thawed during repacking, high bacteria counts in the final pack may result.

Satisfactory compliance.—This item will be satisfied when:

a. All shucked shellfish are received in properly designed ¹⁰ containers. (Returnable containers should be so sealed that any tampering will be evident.)

b. Shellfish are received at a temperature of 50° F. or less. Frozen shellfish which have thawed are not repacked or repackaged.

2. Refrigeration During Repacking.—The temperature of the shellfish shall not exceed 50° F. during the repacking process. Frozen shellfish shall not be thawed during the repacking process.

Public-health reason.—Bacteria multiply rapidly at high temperatures, but are unable to do so at low temperatures. Adequate cooling, therefore, helps to produce a low bacteria count in the final product.

TABLE III.

Item number in Section B	Item	Applicable satisfactory-compliance items
2	Plant arrangement.....	a, d, and e.
4	Floors.....	all items.
5	Walls and ceilings.....	all items.
6	Fly-control measures.....	all items.
7	Lighting.....	all items.
8	Heating and ventilation.	b.
9	Water supply.....	all items.
10	Plumbing and related facilities.	all items.
11	Sewage disposal.....	all items.
12	Rodent control.....	all items.
14	Construction of utensils and equipment.	all items.
15	General cleanliness.....	all items.
16	Cleaning of buildings and equipment.	a, b, d, e, f, and g.
17	Bactericidal treatment of utensils and equipment.	all items.
18	Storage of equipment.....	all items.
19	Source of shellfish.....	all items.
23	Handling of single-service containers.	all items.
24	Packing of shucked shellfish.	c, d, e, f, and g.
26	Ice.....	all items.
27	Records.....	all items.
28	Health of personnel.....	all items.
29	Supervision.....	all items.
30	Cleanliness of employees.	a, b, d, e, and f.

¹⁰ See Section B, Item 14.

Satisfactory compliance.—This item will be satisfied when:

a. The internal temperature of nonfrozen shellfish being repacked does not exceed 50° F. during the repacking process. (This may be accomplished by expeditious handling, by continuous refrigeration of the shellfish being repacked, or by the provision of a refrigerated room for the repacking operation.)

b. Frozen shellfish are not thawed during the repacking process.

3. Cleaning of Returnable Shipping Containers.—Returnable shipping containers shall be thoroughly cleaned as soon after emptying as is practicable.

Public-health reason.—Containers are most easily cleaned before the organic material has had time to dry.

Satisfactory compliance.—This item will be satisfied when returnable shipping containers are thoroughly cleaned as soon after emptying as is practicable.

Section E

RESHIPPERS

Certain States have found it advantageous to license wholesalers who reship shellfish from certified shell-stock shippers, shucker-packers, or repackers to other certified shippers or to final consumers. Such shippers are classed as reshippers. Use of this shipper classification is left to the option of the State. (A reshipper is not permitted to shuck shellfish, nor to repack shucked shellfish.)

Plant requirements for a reshipper depend upon the type of product handled. If shell stock are handled, the applicable requirements outlined for a shell-stock dealer must be met. If only processed shellfish are handled, the requirements are: (1) identification, as described in Section B, Item 24f; (2) refrigeration, as described in Section B, Item 25; and (3) records, as described in Section B, Item 27.

Appendix A

INSPECTION OF CERTIFIED SHELLFISH SHIPPERS

General: Section A-2 of Part I specifies that shellfish shippers certified by States under the Cooperative Program shall meet the construction requirements of Part II of this manual prior to certification, and shall maintain satisfactory sanitary conditions during periods of operation. Establishments not meeting these two requirements will not be eligible for inclusion on the Public Health Service list of State certified shellfish shippers.

Plants will be considered as meeting the basic sanitary standards of part II of this manual when the two following conditions are met: (1) the same sanitation item is not violated repeatedly, and (2) a sanitation rating of at least 80 percent, as determined by a standardized inspection procedures, is achieved.

Sanitation ratings of shucker-packer and repacker establishments should be determined by use of an inspection report equivalent to PHS-769, a copy of which is included as page 28 of this manual. The percentage values assigned to each item are shown on the sample inspection report. Percent values are not shown for items B-1, B-19, C-1, C-2, D-1, D-2, and D-3 since any violations of these items are applied against the tentative percentage rating for the plant. Percentage values for these items are given in table IV. Section C of the inspection report (PHS-769) should not be used unless the shucker-packer ships a portion of his product in the shell. Section D of the inspection report (PHS-769) should not be used unless the shucker-packer also repacks shellfish.

Sanitation ratings for shell stock shippers should be determined by use of an inspection report equivalent to the "Shell Stock Shipper Inspection Report," a copy of which is included as page 29 of this manual. The per-

centage values assigned to each item are shown on the sample inspection report.

Sanitation Ratings for Shucker-Packers: In computing a sanitation rating for a shucker-packer the violations recorded under section B on the inspection report should be totaled using the indicated percentage values. This total, when subtracted from 100, will give a tentative percentage sanitation rating. If items B-1 or B-19 are violated an additional 25 percent or 50 percent should be subtracted from the tentative rating (see table IV). Similarly any violations recorded under sections C and D should also be subtracted according to the table IV schedule.

TABLE IV

Percentage Values for Use in Establishing Sanitation Ratings of Shucker-Packers by Use of Standardized Inspection Report, PHS-769

Section	Item number	Item	Percent values
B	1	Wet Storage.....	25
	19	Source of Shellfish.....	25
C	1	Shell Stock Washing.....	1
	2	Shell Stock Shipping Container.....	2
D	1	Shellfish for Repacking....	2
	2	Refrigeration.....	4
		Frozen Shellfish.....	1
	3	Returnable Containers, Cleaned.....	1

Sanitation Ratings for Repackers: The instructions for rating a shucker-packer should be followed in rating a repacker except that section B items not applicable to the operation of the repacker should be indicated on the inspection report and should be taken into consideration in computing the tentative sanitation rating according to the following formula:

$$\text{Tentative sanitation rating (percent)} = \frac{(\text{Percent compliance section B}) (100)}{(\text{Percentage of section B applicable})}$$

Any violations noted for items B-1, B-19, C-1, C-2, D-1, D-2, or D-3 should be subtracted from the tentative rating according to the table IV schedule to obtain a final rating.

Sanitation Ratings for Shell Stock Shippers: The required physical facilities and operating procedures for shell stock shippers varies with the type of establishment. There-

fore, all items on the inspection report will not apply to every shipper. (See section C, Part II, this manual.) In completing the inspection report those items which are not applicable to the particular shipper should be so indicated. These "not applicable" items should be taken into consideration in computing the sanitation rating for the shipper according to the following formula:

$$\text{Sanitation rating (percent)} = \frac{(\text{Percent compliance}) (100)}{(\text{Percent applicable})}$$

SHUCKING-PACKING PLANT INSPECTION REPORT

PLANT NAME AND LOCATION

SAMPLE

CERTIFICATE NO.

PRODUCT

NUMBER OF SHUCKERS

SECTION B (SHUCKING - PACKING)		13. CONSTRUCTION OF BENCHES:		24. PACKING SHUCKED SHELL FISH:	
1. WET STORAGE:		Smooth; impervious; self-draining.....	2.0	Shellfish not contaminated during packing.....	1.0
Protected; State approved.....	*	Blocks easily cleanable; non-toxic	0.5	Containers closed as soon as feasible.....	1.0
2. PLANT ARRANGEMENT:		Stalls & stools cleanable; painted.....	0.5	Clean, properly-designed containers.....	0.5
Not subject to flooding.....	2.0	No attached padding on stools	0.5	Containers properly identified.....	1.0
Separate shucking and packing rooms	1.0	14. EQUIPMENT CONSTRUCTION:		25. COOLING SHUCKED SHELL FISH:	
Proper delivery window	0.5	Material; smooth surfaces & joints; good repair; easily cleanable.....	2.5	Packed in 1 hr. & cooled to 50° in 2 hrs., or...	2.5
Adequate packing & clothing rooms.....	1.0	Container rims 2' above floor.....	0.5	Cooled to 50° in 2 hrs. in holding containers and kept below 50° thereafter.....	2.5
3. DRY STORAGE OF SHELL STOCK:		Blower not connected directly to sewer.....	0.5	Frozen and stored at 0° or less	0.5
Floors, impervious, graded to drain.....	1.0	Blower air intake protected.....	0.5	26. ICE:	
Walls, smooth, well-constructed.....	0.5	15. GENERAL CLEANLINESS:		From approved source; protected from contamination; washed.....	1.5
Conveyances easily-cleanable; clean.....	0.5	No miscellaneous equipment or material....	1.0	27. RECORDS: Purchases and sales	1.5
Not used as passageway	0.5	Plant used only for shellfish.....	0.5	28. PERSONNEL HEALTH:	
Floor drain protected against backflow.....	0.5	No animals, fowl, unauthorized persons ...	1.0	Infected persons and carriers excluded	1.5
4. FLOORS:		Premises clean; no rubbish.....	0.5	29. SUPERVISION: Effective.....	3.0
Impervious; smooth; graded to drain	1.0	Shuckers do not go into packing room.....	0.5	30. CLEANLINESS OF EMPLOYEES:	
5. WALLS AND CEILINGS:		16. CLEANING:		Clean aprons or coats; properly stored.....	1.0
Smooth; washable; light-colored.....	2.0	Building & equipment cleaned within 2 hrs.	2.0	Finger cots sanitized; no tobacco used	0.5
6. FLY CONTROL MEASURES:		Benches and blocks disinfected weekly....	0.5	Packing-room workers wear rubber gloves or wash and disinfect hands.....	2.0
Adequate screens or fans; self-closing, outward-opening screen doors.....	1.5	Adequate sinks, detergents and brushes....	0.5	Handwashing by employees	2.0
Approved internal fly-control measures.....	1.0	Blowers and tanks rinsed between uses....	0.5	SECTION C (SHELL STOCK)	
Free from flies.....	1.0	Refrigerators clean	0.5	1. WASHING SHELL STOCK:	
7. LIGHTING:		17. BACTERICIDAL TREATMENT OF EQUIPMENT: Approved	2.0	Shell stock clean at time of shipment.....	*
Ample; properly distributed	2.0	18. STORAGE OF EQUIPMENT:		Wash water from approved source (See item 9)	
8. HEATING AND VENTILATION:		Treated equipment properly stored.....	1.5	2. SHIPPING SHELL STOCK:	
Comfortable temperature; well ventilated	0.5	19. SOURCE OF SHELLFISH:		Shipping containers clean, identified	*
9. WATER SUPPLY:		Approved	*	SECTION D (REPACKING)	
Safe; adequate quantity	15.0	20. SHELL STOCK COOLING:		1. SHELLFISH FOR REPACKING:	
Outlet in each room	0.5	Refrigerated or protected as necessary.....	1.0	In approved containers at 50° or less	*
Ample; regulated, hot-water supply	2.0	21. SHUCKING SHELLFISH:		2. REFRIGERATION DURING REPACKING:	
Hot & cold water at each sink vat.....	0.5	Wash water from approved source (See item 9).....		Temperature does not exceed 50°.....	*
10. PLUMBING AND RELATED FACILITIES:		Shell stock free of mud.....	1.0	Frozen shellfish not thawed.....	*
Approved, no cross-connections.....	6.0	On bench more than 2 hours above 50°	2.0	3. CLEANING OF RETURNABLE CONTAINERS:	
Adequate number and location of lavatories; hot and cold water; mixing valves; soap; single-service towels.....	2.0	Dip buckets not used.....	0.5	Cleaned soon after emptying.....	*
Handwashing signs posted.....	0.5	Shucking containers rinsed after each use..	0.5	REMARKS	
Adequate number and location of toilets; clean; good repair; ventilated; lighted; supply of toilet tissue	2.0	22. SHELL DISPOSAL: Prompt	0.5	*These items not included in computation of initial sanitation rating for Shucker-Packers.	
Toilet room doors, self-closing, tight.....	1.0	23. SINGLE-SERVICE CONTAINERS:			
No overhead drains.....	0.5	Store rooms clean, no rodents, trash, insects.....	1.5		
11. SEWAGE DISPOSAL: Satisfactory.....	1.0	Kept clean and dry until used.....	1.5		
12. RODENT CONTROL:		Contaminated containers sanitized or discarded.....	1.0		
Rodent free; proper construction.....	1.5				
Safe use and storage of rodenticides.....	1.0				

DATE Sanitarian

SHELL STOCK SHIPPER INSPECTION REPORT

CERTIFICATE

PLANT NAME AND LOCATION

PRODUCT

NUMBER OF EMPLOYEES

Items not applicable to shipper being inspected should be indicated in appropriate block as "NA"

SECTION B

1. WET STORAGE:

PROTECTED; STATE APPROVED 20

3. SHELL STOCK STORAGE:

FLOORS, IMPERVIOUS, GRADED TO DRAIN 2

WALLS, SMOOTH, WELL-CONSTRUCTED 1

CONVEYANCES EASILY-CLEANABLE; CLEAN 1

NOT USED AS A PASSAGEWAY 1

FLOOR DRAIN PROTECTED AGAINST BACKFLOW 1

9. WATER SUPPLY:

SAFE; ADEQUATE QUANTITY 20

10. PLUMBING AND RELATED FACILITIES:

APPROVED; NO CROSS-CONNECTIONS 3

LAVATORIES; SOAP; SINGLE-SERVICE TOWELS, ... 2

HANDWASHING SIGNS POSTED 1

TOILET ROOMS CLEAN; GOOD REPAIR; VENTILATED; LIGHTED; SUPPLY OF TOILET TISSUE... 2

TOILET ROOM DOORS SELF-CLOSING, TIGHT 1

NO OVERHEAD DRAINS 3

11. SEWAGE DISPOSAL:

SATISFACTORY 2

12. RODENT CONTROL:

RODENT FREE; PROPER CONSTRUCTION 2

SAFE USE AND STORAGE OF RODENTICIDES 2

15. GENERAL CLEANLINESS:

NO MISCELLANEOUS EQUIPMENT OR MATERIAL 2

NO ANIMALS, FOWLS, UNAUTHORIZED PERSONS... 2

DATE

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15. GENERAL CLEANLINESS (Cont'd):

PREMISES CLEAN; NO RUBBISH 1

19. SOURCE OF SHELLFISH:

APPROVED 20

20. SHELL STOCK COOLING:

REFRIGERATED OR PROTECTED AS NECESSARY 2

27. RECORDS:

PURCHASES AND SALES 3

28. PERSONNEL HEALTH:

INFECTED PERSONS AND CARRIERS EXCLUDED .. 3

SECTION C

1. WASHING SHELL STOCK:

SHELL STOCK CLEAN AT TIME OF SHIPMENT 1

WASHWATER FROM APPROVED SOURCES
(SEE ITEM 9)

2. PACKING AND SHIPPING SHELL STOCK:

SHIPPING CONTAINERS CLEAN 1

SHIPMENTS PROPERLY IDENTIFIED 1

REMARKS:

(Sections and item numbers refer to PHS Publication 33, Part II, Rev. 1957.)

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